THE

Practical Teacher

A MONTHLY EDUCATIONAL JOURNAL.

Edited by JOSEPH HUGHES.

'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

VOL. VII. NO. 10. DECEMBER, 1887. PRICE, 6D. POST FREE, 7½D.

Animal Physiology.

BY ARTHUR NEWSHOLME, M.D., AND C.S.S. (LOND.)

VOICE AND SPEECH—*continued.*

The muscles concerned in acting on the vocal chords and thus producing vocal sounds are nine in number, each named after the cartilages to which they are fixed. They are in pairs except the arytenoid muscle.

The *crico-thyroid* muscles, already named, render tense and elongate the vocal chords, by pulling forward and downward the anterior border of the thyroid cartilage.

The *posterior crico-arytenoid muscle* on each side arises from the lateral part of the posterior surface of the cricoid; its fibres passing upwards and outwards to be inserted into the outer angle of the base of the arytenoid cartilage. A reference to fig. 86 illustrates its action. It separates the vocal chords and thus opens the glottis by rotating the base of the arytenoid cartilage on its axis, outwards and backwards.

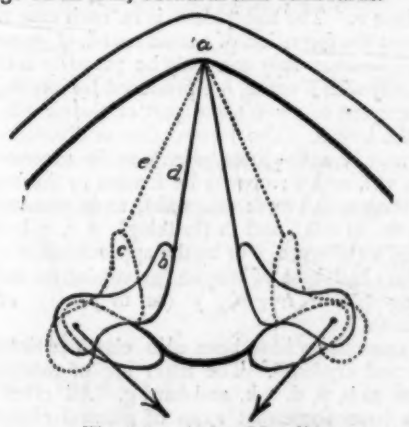


Fig. 86. (After Mandl.)

Diagram of action of posterior crico-arytenoid muscles:—*a*, anterior border of thyroid cartilage; *b*, arytenoid cartilage; *c*, new position of arytenoid (dotted lines); *d*, vocal chord; *e*, new position of vocal chord (dotted lines). The muscles work in the direction of the arrow.

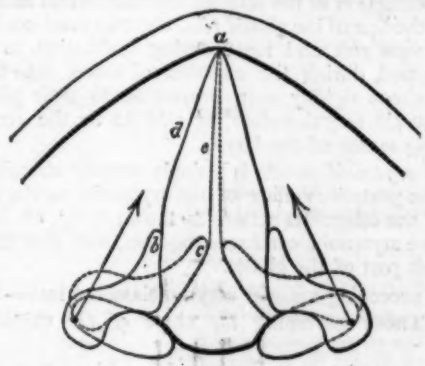


Fig. 87.

Diagram of action of lateral crico-arytenoid cartilages (lettering as before). Arytenoid cartilages and vocal chords brought into position indicated by dotted lines.

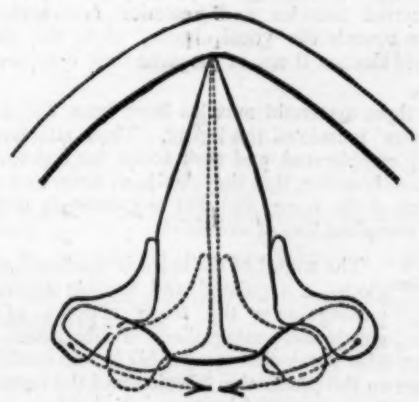


Fig. 88.

Diagram of action of arytenoid muscle, in direction indicated by arrows. New position of vocal chords and cartilages indicated by dotted lines.

The *lateral crico-arytenoid muscle* is smaller than the last. It arises from the upper border of the side of the cricoid cartilage, and passes upwards and backwards to be inserted into the outer angle of the

BRITISH MUSEUM

arytenoid cartilage in front of the last muscle. Its action, as shown in fig. 87, is to rotate the base of the arytenoid cartilages inwards and thus approximate their anterior angles, and consequently the vocal chords attached to these anterior angles.

The *thyro-arytenoid muscle* is a broad flat muscle in the interior of the larynx, which lies parallel with the outer border of each true vocal chord. It stretches from its anterior attachment to the inner edge of the front of the larynx to the anterior surface of the arytenoid cartilage behind. There is much difference of opinion as to the action of the two thyro-arytenoid muscles. The ordinary opinion is founded on the anatomical knowledge of their attachments. It would appear from this that they would tend to draw the arytenoid cartilages forwards, and thus relax the vocal chords. According to Mandl, however, these muscles form the two physiological vibrating organs of voice; and it is quite certain that the vocal chords (commonly so called), being adherent to these muscles, can only act in association with them. To quote his words 'the contraction of the internal thyro-arytenoid muscle causes the lips of the glottis (*i.e.*, the true vocal cords), which were soft and loose during respiration, to be transformed, during the emission of voice, into true reeds, whose rigidity is in proportion to their pitch. This muscle may therefore be said to be the *accommodating muscle* of the larynx.'

The *arytenoid muscle* is a single muscle stretching from the posterior surface of one arytenoid cartilage to that of the other. Its action, as shown in fig. 88, is to draw the arytenoid cartilages together, and thus close the back part of the glottis.

The preceding muscles may be classified into—

(1) Those governing *the shape of the* chink or *glottis.*

The posterior crico-arytenoid muscles open the glottis. The lateral crico-arytenoid muscles and the arytenoid muscle close the glottis, assisted by the thyro-arytenoid muscle.

(2) Those governing *the pitch of the voice.* The crico-thyroid muscles and posterior crico-arytenoid muscles stretch the vocal chords, while the thyro-arytenoid slacken them, at the same time compressing them.

The thyro-arytenoid muscles have been called the 'sphincter' muscle of the larynx. Their attachments are very complicated, and their action not less so. It is certain, however, that they can both lower and raise the pitch of the voice, and that any paralysis of them causes complete loss of voice.

Mechanism of Voice.

The sound of the voice is produced at the glottis, a regulated and forcible expiration passing over the tense margins of the glottis and setting them in vibration. The upper or false vocal chords probably have a modifying influence on the production of voice, and the ventricles between the upper and lower vocal chords serve to separate the two, to allow the sound waves to expand laterally, and probably also by their mucous secretion to moisten the vocal chords. The falsetto voice has been said by some to be produced by vibration of the upper vocal chords, but this is probably not correct. The more generally accepted view is that the falsetto voice is produced by vibration of the edges of the true vocal chords.

Three registers are generally described in the voice: the chest-register, the falsetto-register, and head-register.

The *chest-register* is the voice commonly used in speaking. It is produced by vibrations of the vocal chords (including perhaps the thyro-arytenoid muscles), the higher notes being produced by increased tension of these chords. The chest voice is confined within certain limits, and beyond these must pass into the head-voice or the falsetto.

The average *compass of the voice* is about two octaves. The lowest note of the female voice is about an octave higher than the lowest of the male voice; the entire maximum scale of the human voice including about four octaves. There are three kinds of male voice—bass, baritone, and tenor, and three kinds of female voice—contralto, mezzo-soprano, and soprano. The essential difference between these is not in the height of scale to which they can reach, but in their ease of production and *tone or 'timbre,'* which distinguishes them even when singing the same note.

The different *pitch* of the male and female voices depends on the different length of their vocal chords, which is in the relative proportion of three to two. The difference in timbre is owing partly to difference in the mechanism of production of the voices, and partly to the different nature and form of the resounding walls. The larynx of boys resembles the female larynx; the vocal chords having only two-thirds the length they subsequently attain.

The *falsetto voice* is said to be caused by vibration of the free edges only of the vocal chords.

The *head register*, which must not be confounded with the falsetto, differs from the chest register in the fact that while in the emission of sound in the chest register the glottis vibrates throughout its whole length, in the head register only the anterior segments of the vocal chords vibrate.

Mechanism of Speech.

Speech consists of the voice sounds produced in the larynx, modified as they pass upwards and outwards. The *vowels* are produced at the glottis, and but little modified afterwards. The mouth cavity is varied in size and shape to produce the different vowels, being of largest size to produce *a* (as in *far*), and smallest to produce *u*. The soft palate is in each case raised to prevent the formation of a nasal sound. *Consonants*, so called because they can only be properly sounded *consonantly* with a vowel, are produced by interruption of the current of air in some part of the air passages above the larynx. The interruption or obstruction of bound may be at the lips (*labials*), as in pronouncing s, p, m, v, f, and w; or may be formed by the margin of the tongue and teeth (*linguals*), as in pronouncing d, t, n, th (in this), and th (in thing), s, z, r, l, sh (in *she*), and z (in azure); or by the approximation of the soft palate and base of tongue (gutturals), as in hard g, k, ng (as in *tongue*), y (as in *youth*), or the German ch.

The consonants have been also classified into *continuous* and *explosive*. The latter are of momentary duration, as b, p, d, t, k, and hard g. All other consonants have somewhat more of a vowel character; in forming them the barriers are but imperfectly closed, whence their name *continuous*. The consonant *h* occupies a peculiar position. It is produced by an escape of air being allowed through the glottis before the subsequent articulate sound is produced.

(To be continued.)

Knitting Maps.

BY MRS. J. D. HARRIS.

SECTION OF LADY'S SHOULDER CAPE.

2 Bone pins. No. 10 Chamber's bell gauge.

1 lb. double Berlin wool.

Cast on 30 stitches. Knit 4 plain rows, slipping the 1st stitch, and knitting the last of every row.

A. Knit one row of loops.

(This is done by putting the wool in each stitch over the pin, and the two first fingers of the left hand twice, or three times if the wool is fine. In the reverse row the loops on the pin are knitted together as one stitch).

Knit 4 plain rows.

Repeat from A. till you have 8 rows of loops.

To decrease towards the Neck.

B. Knit the 2 first, and the 2 last stitches of the row *before the loops* together.

C. When you have 17 rows of loops add 2 or 3 more rows without decreasing and cast off.

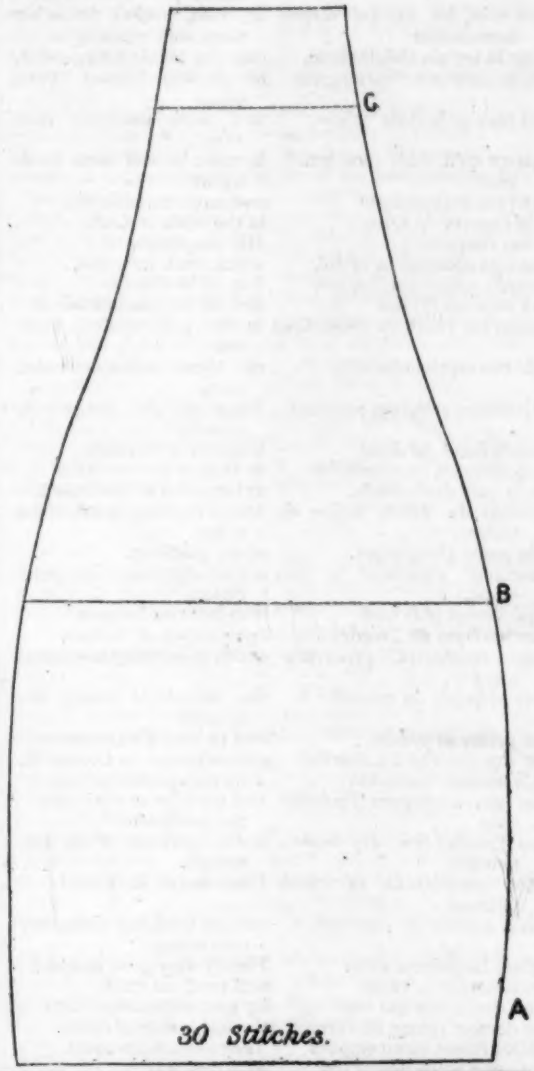
Nine of these sections must be knitted exactly alike, and sewn neatly together on the wrong side.

The band for the neck can be made in two ways.

Cast on 12 stitches. Knit loops in the 1st six stitches—the last six plain. Knit the length required for the neck. Sew the loops on the right side, and turn the plain part over at the back. This will form an upright collar. Or cast on about 85 stitches, or as many as will make the size of the neck. Knit 1 row of loops. Then a row of holes, then 4 plain rows and cast off. Sew the loops down on the right side, and turn the plain part over at the back. Put a cord and balls at the neck and another to tie about 3 inches down.

To make the Balls.

Cut a square in cardboard, about 2 inches, with a hole in the centre. Wind the wool both ways, tie it firmly in the middle, and cut it at the edges of the card.



Christopher Columbus, by Lamartine.

TRANSLATED BY A. M. BOWER, F.R.G.S.,

Late Master in University College School, London.

CHRISTOPHE COLOMB. CHRISTOPHER COLUMBUS.

PREMIÈRE PARTIE. FIRST PART.

CHAPTER XVIII.—*continued.*

Saint Augustin avait été plus loin, il avait taxé d'iniquité	St. Augustine had gone further, he had taxed with crime
la seule foi dans les antipodes:	the very notion of antipodes:
'Car,' disait-il, 'ce serait supposer des nations	'For,' said he, 'that would be to suppose nations
qui ne descendent pas d'Adam :	who do not owe descent to Adam :
or La Bible dit que tous les hommes descendent d'un seul et même père.'	Now the Bible states that all men spring from one and the same father.'
D'autres docteurs, prenant une métaphore poétique	On the other hand, the doctors, adopting a poetical metaphor
pour un système du monde,	to explain a world formation
citaient au géographe	quoted to the geographer
ce verset du psaume où il est dit	that verse of the Psalm where it is written
que Dieu étendit le ciel	that God spread out the heaven
sur la terre comme une tente.	over the earth like a tent,
d'où il resultait, selon eux,	from which there resulted according to them,

que la terre devait être plate.
Colomb répondait en vain

à ses interlocuteurs
avec une piété
qui n'excluait pas la nature ;
en vain, les suivant respectueusement
sur le terrain théologique,
il se montrait plus religieux

et plus orthodoxe qu'eux,

parce qu'il était plus intelligent
et plus enthousiaste
de l'œuvre de Dieu.
Son éloquence,
que passionnait la vérité,
perdit toutes ses fondres
et tous ses éclairs
dans les ténèbres volontaires

de ces esprits obstinés.

Quelques religieux parurent

seuls émus de doute
on ébranlés de conviction
à la voix de Colomb.
Diego de Deza, moine de l'ordre
de Saint-Dominique,
homme supérieur à son siècle,
qui devint plus tard
archevêque de Tolède,
osa combattre généreusement
les préjugés du conseil,

et prêter sa parole
et son autorité à Colomb.
Ce secours inattendu
ne put surmonter l'indifférence
ou l'obstination des examinateurs.
Les conférences se multiplièrent
sans amener de conclusion.

Elles languirent enfin
et lassèrent la vérité
par des délais qui sont
le dernier refuge de l'erreur.
Elles furent interrompues
par une nouvelle guerre
de Ferdinand et d'Isabelle
contre les Maures de Grenade.

Colomb, ajourné, attristé,

méprisé, éconduit,

soutenu par la seule faveur
d'Isabelle, et par la conquête

de Diego de Deza
à sa théorie, suivit
misérablement la cour
et l'armée de campement
en campement,
et de ville en ville,
en épiant en vain
une heure d'attention
que le tumulte des armes

that the earth must be flat.
Columbus made answer in vain

to these questioners
with a piety
which did not exclude nature ;
in vain, (while) following them with courtesy
over the theological ground,
he showed himself more pious

and more orthodox than they,

because he was more intelligent
and more enthusiastic
in the work of God.
His eloquence,
which truth inflamed,
lost all its thunder
and its fire (lit. lightning)
in the self-imposed darkness

of these self-opinionated men.

Some of the clergy only seemed

troubled with doubt
or shaken by conviction
at the voice of Columbus.
Diego de Deza, monk of the order
of St. Dominic,
a man superior to his generation,
who later on became
Archbishop of Toledo,
dared generously to combat

the prejudiced among the council

and to lend his eloquence
and influence to Columbus.
This unexpected succour
was not able to overcome the indifference
or the obstinacy of the examiners.
Conferences multiplied

without bringing about any conclusion.

Finally they grew languid
and tired out truth
by procrastination which is
the last refuge of error.
They were interrupted
by a new war
of Ferdinand and Isabella
against the Moors of Granada.

Columbus, shelved, saddened,

scorned and spurned (discarded),

sustained only by the favour
of Isabella, and by the conquest

of Diego de Deza
to his theory, followed
mournfully the court
and the army from camp
to camp,
and from town to town,
while watching in vain for
an hour's consideration
which the din of arms

l'empêchait d'obtenir.

La reine cependant,
aussi fidèle à la faveur
secrète qu'elle lui portait
que la fortune lui était adverse,
continuait à bien espérer

de ce génie méconnu
et à le protéger.

Elle faisait réserver à Colomb
une maison ou une tente
dans toutes les haltes de la cour.
Son trésorier était chargé
d'entretenir le savant étranger,
non en hôte importun
qui mendie des secours,
mais en hôte distingué
qui honore le royaume

et que les souverains veulent

retenir à leur service.

prevented him from obtaining.

The queen, however,
as constant to the secret
favour which she gave him
as fortune was fickle to him,

continued to form high hopes

of this unknown genius
and to extend her protection to him.
She had reserved for Columbus
a house or a tent
everywhere the court halted.
Her treasurer was charged
to maintain the stranger scientist,
not as an importunate guest
who begs for support,
but as an eminent guest
who is-conferring-honour on a kingdom

and whom the sovereigns wish

to keep in their service.

CHAPTER XIX.

Ainsi s'écoulèrent plusieurs années,
pendant lesquelles le roi de Portugal,
le roi d'Angleterre,
et le roi de France,
ayant entendu parler
par leurs ambassadeurs
de cet homme étrange qui
promettait un nouveau monde
aux rois, firent tenter Colomb

par des propositions
d'entrer à leur service.
La tendre reconnaissance
qu'il avait vouée à Isabelle
et l'amour qu'il portait à doña

Béatrix Enriquez de Cordoue,

déjà mère de son second fils

Fernando, lui firent écarter

ces offres et le retinrent
à la suite de la cour.
Il réservait à la jeune reine

un empire en retour
de sa bonté pour lui.
Il assista au siège
et à la conquête de Grenade.

Il vit Boabdil rendre
à Ferdinand et à Isabelle
les clefs de cette capitale,
les palais des Abencérages,

et la mosquée de l'Alhambra.

Il fit partie du cortège

des souverains espagnols
à leur entrée triomphale

Thus rolled away several years,
during which time the king of Portugal,
the king of England,
and the king of France,
having heard tidings
through their ambassadors
of that strange man who
promised a new world
to kings, tempted Columbus

by proposals that he
should enter their service.
The tender gratitude
that he had sworn to Isabella
and the love which he bore towards

Donna Beatrix Enriquez of Cordova,

already the mother of his second son

Fernando, made him fling away

these offers, and kept him
in the royal suite.
He reserved for the young queen

an empire as a return
for her kindness to him.
He was present at the siege
and at the conquest of Granada.

He saw Boabdil yield
to Ferdinand and Isabella
the keys of that capital,
the palace of the Abencérages,

and the mosque of the Alhambra.

He formed part of the procession

of the Spanish sovereigns
on the occasion of their triumphal entry

dans ce dernier asile de l'islamisme.
into that last refuge of Islamism.

Il voyait au delà de ces remparts
He saw beyond those ramparts

et de ces vallées de Grenade d'autres conquêtes
and those valleys of Granada other conquests

et d'autres entrées triomphales
and other triumphal entries

dans de plus vastes possessions.
into larger possessions.

Tout lui semblait petit,
All seemed to him a little thing

comparé à ses pensées.
as compared to his projects.

La paix qui suivit cette conquête
The peace which followed that conquest

en 1492 motiva une seconde réunion
in 1492 brought about a second reunion

d'examinateurs de ses plans à Séville, pour donner
of the examiners of his plans at Seville, to give

leur avis à la couronne.
their advice to the crown.

Cet avis, combattu en vain,
This advice, in vain opposed

comme à Salamanque
as at Salamanca

par Diego de Deza,
by Diego de Deza,

fut de rejeter les offres
was to reject the offers

de l'aventurier Génois,
of the Genoese adventurer,

sinon comme impies,
if not as impious,

au moins comme chimériques
at all events as chimerical,

et compromettantes pour la dignité
and compromising to the dignity

de la cour d'Espagne,
of the Spanish court,

qui ne pouvait autoriser
which could not possibly sanction

une entreprise
an enterprise

sur d'aussi puérils fondements.
(based) on such slight foundations.

Ferdinand, influencé néanmoins
Ferdinand, influenced nevertheless

par Isabelle, adoucit
by Isabella, softened down

la dureté de cette résolution
the harshness of this resolution

du conseil en la communiquant
of the council in communicating it

à Colomb.
to Columbus.

Il lui fit espérer qu'aussitôt
He gave him hopes that immediately

après la tranquille possession
after the tranquil possession

de l'Espagne par l'expulsion
of Spain by the complete expulsion

achevée des Maures,
of the Moors,

la cour favoriserait de ses subsides
the court would favour with its subsidies

et de sa marine
and with its navy

l'expedition de découverte
the expedition of discovery

et de conquête dont
and conquest with which

il l'entretenait
he (Col.) had entertained him (Ferd.)

depuis tant d'années.
for so many years.

CHAPTER XX.

En attendant,
While waiting for,

sans trop d'illusions,
without too many illusions,

l'accomplissement toujours ajourné,
the accomplishment always put off,

des promesses du roi et des désirs
of the promises of the king and of the

plus sincères d'Isabelle,
more sincere wishes of Isabella,

Colomb tenta deux grands
Columbus tried to persuade two

seigneurs espagnols,
powerful Spanish noblemen,

le duc de Medina-Sidonia
the Duke of Medina-Sidonia

et le duc de Medina-Celi,
and the Duke of Medina-Celi,

de faire à leurs frais
to undertake at their own expense

cette entreprise.
this enterprise.

L'un et l'autre possédaient
Both possessed

des ports et des navires
ports and vessels

sur la côte d'Espagne.
on the coast of Spain.

Ils sourirent d'abord
They smiled at first

à ces perspectives de gloire
on these vistas of glory

et de possessions maritimes
and maritime possessions

pour leur maison,
for their families,

puis ils les abandonnèrent
then they threw them aside

par incrédulité
in a fit of incredulity

ou par indifférence.
or indifference.

L'envie s'acharnait sur Colomb,
Envy fastened itself on Columbus,

même avant qu'il l'eût
even before he had

méritée par un succès :
deserved it by success.

Elle le persécutait,
It followed him up,

comme par anticipation et par instinct,
as if by anticipation and instinct,

jusque dans ses espérances.
even into his hopes.

Elle lui disputait ce qu'elle appelait ses chimères.
It called in question what it termed his chimeras.

Il renonça de nouveau
Again he renounced

avec larmes à ces tentatives.
these attempts with tears in his eyes.

La froideur des ministres
The coldness of the ministers

à l'écouter,
in listening to him,

l'obstination des moines
the pertinacity of the monks

à repousser ses idées
to reject his notions

comme une impiété de la science,
as if it were an impiety of science,

les vaines promesses
the vain promises

et les éternels ajournements
and everlasting adjournments

de la cour le jetèrent,
of the court threw him,

après six années d'angoisses,
after six years of tribulation,

dans un tel découragement
into such despondency

qu'il renonça définitivement
that he definitely abandoned

à toute sollicitation nouvelle
all further solicitation

auprès des souverains de l'Espagne,
from the sovereigns of Spain,

et qu'il résolut d'aller
and resolved to go

offrir son empire au roi de France,
and offer his empire to the King of France,

dont il avait reçu
from whom he had received

quelques provocations.
some invitations.

Ruiné de fortune,
Ruined in fortune,

abattu d'espérances,
crushed in his hopes,

épuisé d'attente,
worn out with waiting,

et le cœur brisé par la nécessité
and his heart broken at the necessity

de s'arracher à l'amour
of tearing himself away from the love

qui l'attachait à doña Béatrix,
which bound him to Donna Béatrix,

il partit de nouveau
he set out again

à Cordoue à pied,
to Cordova on foot,

sinon avec les perspectives
if with no definite prospect

de l'avenir, du moins
for the future, at all events

pour aller retrouver son fidèle ami,
to go to seek again his faithful friend,

le prieur Juan Perès,
the prior Juan Perès,

au monastère de la Rabida.
at the monastery of La Rabida.

Il se proposait d'y reprendre
He purposed to take therefrom

son fils Diego,
his son Diego,

qu'il y avait laissé,
whom he had left there,

de le ramener à Cordoue,
to bring him to Cordova,

et de le confier avant son départ
and to entrust him, before his departure

pour la France, à doña Béatrix,
for France, to (the care of) Donna Béatrix,

mère de son fils Fernando.
the mother of his son Fernando.

Les deux frères élevés ainsi
The two brothers, thus brought up

par les soins et dans l'amour
by the care and in the love

de la même femme,	of the same woman,
contracteraient l'un pour l'autre	would contract for each other
cette tendresse fraternelle,	that fraternal tenderness
seul héritage qu'il eût	(which was) the only heritage which he
à leur laisser.	had to leave them.

Notes.

CHAPTER XIX.

Ainsi s'écoulèrent plusieurs années. Sentences beginning with *aussi* (so), *à peine* (scarcely), *peut-être* (perhaps), etc., place the *nominative after the verb* (*Eve's Fr. Gram.*, par. 118). *Lui firent écarter ces offres.* The *dative lui* not the accusative *le* is used after *firent* because *écarter* has an accusative (*ces offres*) after it (*Eve's Fr. Gram.*, par. 115). Translate: *I made* (faire) *him* renounce his pretentions (*renoncer à ses prétensions*). Translate: *They caused him to hope the court would favour him.* En la communiquant (*en* = by).

CHAPTER XX.

En attendant (*en* = while). *Avant que* takes subjunctive (*eût*). Translate: *They disputed with him the glory. They renounced their attempts.* Note, la froideur des ministres *à* (= *in*) l'écouter: l'obstination des moines *à* (= *in*) repousser. Translate: *He had received invitations from the king of France. From whom* had he received invitations? The king of France. *Seul* héritage qu'il *eût* à leur laisser (*eût* is subj. after *seul*, *Eve's Fr. Gram.*, par. 236).

(*The end.*)

—o—

Mental Arithmetic, its Principles and Practice.

BY REV. A. D. CAPEL, M.A.,

Author of 'Catch Questions in Arithmetic,' 'Tips in Algebra,' 'Easy Steps in Trigonometry,' etc., etc.

ANSWERS TO EXERCISES.

CHAPTER XXI.

1. $1\frac{3}{10}$
2. $\frac{9}{14}$
3. $1\frac{1}{24}$
4. $5\frac{1}{2}$
5. $3\frac{7}{11}$
6. $1\frac{1}{15}$
7. $\frac{1}{144}$
8. $\frac{1}{144}$
9. $10\frac{1}{15}$
10. $12\frac{1}{11}\frac{3}{5}$
11. $\frac{1}{35}$
12. $\frac{1}{132}$
13. $\frac{1}{12}$
14. $1\frac{1}{15}$
15. $\frac{1}{1716}$
16. $4\frac{1}{12}$
17. $999\frac{7}{11}$
18. $\frac{1}{35}$
19. $1\frac{1}{2}\frac{1}{4}\frac{1}{3}$
20. $\frac{4}{5}$
21. $\frac{1}{12}$
22. $\frac{1}{10}$
23. $\frac{1}{12}$
24. $1\frac{1}{15}$
25. $\frac{1}{150}$
26. $\frac{1}{18}$
27. $1\frac{35}{288}$
28. $\frac{1}{15}$
29. $10\frac{11}{168}$
30. $1\frac{1}{24}$
31. $20\frac{1}{2}$ days.
32. $\frac{1}{15}$
33. 9 days.
34. $\frac{1}{140}$ or $466\frac{2}{3}$ days
35. 240 days
36. 8 days
37. 66 days
38. 30 days
39. 3 days
40. $\frac{1}{15}$
41. $\frac{1}{21}$
42. $\frac{1}{10}$
43. $\frac{1}{11}$
44. $\frac{1}{15}$
45. 3,000 marbles
46. 200 or 5 each
47. 19 yards
48. 5 miles
49. 60 miles
50. 2 miles per hour

Note.—In Example 30, 82 is printed for 8.

CHAPTER XXII.

1. £3 10s.
2. £3 9s. 6d.
3. £13 12s. 6d.
4. £5 14s. 3d.
5. £6 7s. 9d.
6. £17 17s. $4\frac{1}{2}$d.
7. £3 5s. $8\frac{1}{4}$d.
8. £17 12s. $2\frac{1}{4}$d.
9. 5s. $4\frac{1}{2}$d.
10. £28 13s. 9d.
11. 4 tons 15 cwts.
12. 3 miles 2 furlongs
13. 4 a. 20 poles
14. 3 tons 14 cwts. 1 qr.
15. 15 tons 15 cwt. 3 qr. 14 lbs.
16. 3 miles 7 fur. 30 poles
17. 4 oz. 5 drs.
18. 3 a. 3 r. 12 poles
19. 3 oz. 3 dwts. 15 grs.
20. 7 oz. 1 dr. 0 scr. 3 grs.
21. $\frac{3}{10}$
22. $\frac{4}{10}$
23. $\frac{1}{10}$
24. $\frac{3}{10}$
25. $\frac{3}{10}$
26. $\frac{1}{10}$
27. $\frac{1}{10}$
28. $\frac{1}{10}$
29. $\frac{1}{10}$
30. $\frac{1}{10}$
31. $\frac{1}{10}$
32. 888
33. 2170100
34. 11
35. ·0379
36. $\frac{3}{10}$
37. 3·787875
38. 6209·6562
39. $\frac{1}{2}$
40. $\frac{1}{10}$
41. $\frac{1}{2}$
42. $\frac{1}{10}$
43. $\frac{1}{10}$
44. £21718 15s.
45. 103·0225
46. 2·163841
47. 29·402
48. ·021602
49. 61·78
50. 1648·949616

CHAPTER XXIII.

1. 161
2. 84
3. 176
4. 45
5. 165
6. 539
7. 548
8. $\frac{1}{3}$
9. ·00006
10. 60
11. 425
12. 1650
13. 1616
14. 1500
15. 693
16. 1728
17. 625
18. 8451
19. 2889
20. 2200
21. 612
22. 486
23. 1332
24. 1456
25. 1771
26. 720
27. 8460
28. 492
29. 4
30. 504
31. 5 men
32. 560 men
33. 9 days
34. $3\frac{1}{2}$ weeks
35. £1,410
36. 4s. $5\frac{1}{2}$d.
37. £2 2s.
38. $12\frac{1}{2}$
39. £500.
40. $\frac{1}{11}$
41. $\frac{4}{15}$
42. $\frac{1}{5}$
43. $\frac{1}{11}$
44. $\frac{1}{15}$
45. $\frac{1}{11}$
46. 2 men
47. 390
48. 2205
49. $\frac{1}{11}$
50. $\frac{1}{11}$

Note.—In Example 45 we must read greater for less.

CHAPTER XXIV.

ARITHMETICAL PROGRESSION.

204. A series of numbers as 3, 5, 7...41, of which every number is greater by 2 than the one that precedes it, is called an arithmetical progression.

205. Many problems in such series can be performed mentally. *E.g.*, we could write down at once the sum of the first, say, 30 natural numbers, or that of the first, say, 25 odd numbers. We will proceed to explain the method employed.

206. Let us be required to sum the set of numbers 4, 8, 12...44. If we imagine these numbers written in a reverse order thus:

44, 40, 36...4,

we notice that the sum of any term of the 1st series and the same term of the 2nd series is 48; and of these 48s there are 11, since there are 11 terms in the series. ∴ 48 × 11 is double the sum we require, hence

sum = ½ (first + last) × number of terms.

207. Students sometimes find a difficulty in seeing how many terms there are in the series of which he knows the first and second terms and the last term. If he subtract the first term from the last term and divide by the common difference he sees how often he has added on the common difference to produce the last term, hence the number of terms is 1 more than this quotient, *e.g.* in 3, 7, 11...55. The number of terms is 1 more than $\frac{55-3}{4}$ or 14.

208. If the last term is not known we can find it, since if we have any two terms of the series we can find any other term.

209. What is the 8th term of the series 5, 7, 9...?

If we were to carry this out to the 8th term we should find we have added 2 (the common difference) seven (one less than the number of the places of the term requird) times to 5, and so obtain 19, the reason of which is obvious.

210. If we want to sum to ten terms 5, 11, 17..., we must first find the 10th term by adding to 5, 6 nine times, getting 59. Hence our sum is $\frac{1}{2}$ (5 + 59) 10 or 64 × 5 or 320.

211. It is an interesting mental exercise to think out why the result of summing a series of numbers, which of course must give a whole number, should always be integral though the fraction $\frac{1}{2}$ appear in the formula by which he sums them. This will be given as an exercise and explained in the solution.

212. To find any particular term from two terms of a series we proceed thus:

What is the 10th term of the series whose 4th term is 14 and 7th term 23?

Since the 7th term is the 1st term and 6 common differences, and the 4th term is the 1st term and 3 common differences, we see that 3 common differences are 23 — 14, or 9, and hence the common difference is 3; and since the 4th term is the 1st term and 3 common differences, or 9, the 1st term is 5, hence the 10th term is 5 and 27 or 32.

213. If we have 2 terms given and are asked to find the sum of say 10 terms, we must find the 1st term and the 10th term as shown in 212, and the sum as shown in 210.

214. There are some, so to speak, accidental peculiarities about certain series which the student can notice if he choose, but I do not advocate the learning all these particular formulas. Here is one. Let us sum the first eleven odd numbers—
the 11th term = 1 + 10 × 2 or 21,
and the sum = $\frac{1}{2}$ (21 + 1) 11 or 11^2;
hence the formula that the sum of the first n odd numbers is n^2. Similarly the sum of the first n even numbers is $n^2 + n$.

215. EXAMPLES XXIV.

Sum the following ten series:—

1. 3, 5...23
2. 4, 7...34
3. 5, 10...55
4. 7, 11...87
5. 2, 11...83
6. 1, 3...23
7. 4, 8...56
8. 3, 4...17
9. 1, 2...50
10. 2, 4...50

Sum the following ten series:—

11. 3, 11...to 8 terms
12. 5, 6...to 12 ,,
13. 4, 9...to 15 ,,
14. 3, 11...to 9 ,,
15. 5, 6...to 13 ,,
16. 1, 3...to 15 terms
17. 17, 20...to 7 ,,
18. 21, 31...to 8 ,,
19. 5, 7...to 11 ,,
20. 8, 10...to 13 ,,

Find the—

21. 10th term of 2, 4...
22. 13th ,, of 1, 3...
23. 12th ,, of 5, 9...
24. 20th ,, of 5, 10...
25. 15th ,, of 3, 10...
26. 11th term of 3, 11...
27. 13th ,, of 7, 8...
28. 15th ,, of 5, 12...
29. 100th ,, of 1, 5...
30. 1001st ,, of 2, 12...

Find the common difference if—

31. 5th term is 19 and 11th term is 37
32. 7th ,, 33 and 14th ,, 68
33. 9th ,, 23 and 23rd ,, 57
34. 11th ,, 59 and 18th ,, 87
35. 17th ,, 155 and 23rd ,, 209
36. 15th ,, 118 and 100th ,, 713

Write down the first three terms of the series if—

37. 8th term is 84 and 21st term is 227
38. 9th ,, 85 and 19th ,, 185
39. 4th ,, 56 and 17th ,, 199
40. 9th ,, 156 and 16th ,, 205
41. 11th ,, 127 and 18th ,, 204
42. 20th ,, 79 and 30th ,, 109
43. Sum to 6 terms the series 8, 11, 14...
44. ,, 10 ,, 7, 18, 29...
45. ,, 13 ,, 11, 20, 29...
46. Sum to 25 terms 1, 3, 5...
47. Sum to 11 terms the series whose 1st term is 7 and 11th term is 57.
48. Sum to 10 terms the series whose 6th term is 20 and 9th term is 29.
49. Sum to 18 terms the series whose 9th term is 55 and 22nd term is 133.
50. Prove that the formula
$\frac{1}{2}$ (1st term + last term) × number of terms
must be an integer if the first and last terms are both integers.

CHAPTER XXV.

THE AREAS OF RECTANGLES AND TRIANGLES.

216. The student is supposed to know that the area of a rectangle is found by multiplying the number which expresses the length by that which expresses the breadth, and that if these measures be expressed by means of the same linear unit, the number in the product expresses so many squares of which each side is the linear unit to which the length and breadth are referred.

217. The area of a room 14 ft. by 12 ft. or 14 ft. × 12 ft., as it is usually written, is 168 sq. feet; the area of a rectangular farm 2 miles × $\frac{1}{2}$ mile is 1 sq. mile; and the area of a small piece of board 4 in. × $\frac{1}{2}$ in. is 2 square inches.

218. The area of a piece of board 2 ft. × 3 in. is 24 × 3 or 72 square inches, in which operation we reduce the larger denomination to the smaller before we multiply them, and this we must always do if we are expected to give our result in some square unit.

219. If in finding the area of a piece of board 2 ft. × 3 in., we had not reduced the 2 feet to 24 in., but multiplied the 2 by the 3 as they stand our result would have been (as a figure would show) 6 rectangles 1 ft. long and 1 in. broad.

220. There are questions which can be worked mentally, which we should do more easily if we remembered what is stated in 219; *e.g.*, how many bricks 9 in. × 4 in. will it take to face a wall 9 yds. × 10 ft.?

9 yds. = 36 (9 in.) and 10 ft. = 30 (4 in.)

If we multiply a number of nine inches by a number of four inches our product will be so many rectangles 9 in. × by 4 in., but this is the face of the brick, the number of which we want to find; hence our result is 36 × 30 or 1080.

221. The usual way of finding this number would be thus:

$$\frac{9 \times 3 \times 12 \times 10 \times 12}{9 \times 4}$$

which of course gives us the same result, but there are many more numbers to retain in the memory.

222. If we know the area and one side of a rectangle we can easily find the other by dividing the area by the length, taking care that the square unit of the area is the square on the linear unit of the given side; *e.g.*, how long is the rectangle which contains 204 square inches if the breadth is 1 foot?

The length is $\frac{204}{12} = 17$ in. or 1 ft. 5 in.

223. The area of a triangle is half the rectangle on the same base and of the same altitude; if therefore we know these two elements we can at once write down the area of the triangle.

224. Here is the formula for finding the area of a triangle, where the three sides are known, but, except in very easy cases, it would be difficult to retain the numbers in the memory.

If the three sides are a, b, c,

and $2s = a + b + c$

$$\text{area} = \sqrt{s\,(s-a)\,(s-b)\,(s-c)},$$

for an explanation of which I must refer the student to my Catch Questions in Arithmetic and Mensuration, pages 263—4.

225. Let us find the area of the triangle whose sides are 13, 20, and 21. Half their sum is 27.

We have then to find the square root of 27 × 14 × 7 × 6, which we mentally arrange thus: $3^2 \times 3^2 \times 7^2 \times 2^2$, of which the square root is 126.

∴ the area contains 126 square units.

226. We could easily obtain the length of the perpendicular on anyone of the sides; *e.g.*, what is the length of the perpendicular on the side 20?

$\frac{1}{2}$ perp. × 20 = 126.

∴ perp. = $12\frac{6}{10}$.

227. If the measurements are given in more than one denomination, it is as well to express the smaller denomination as a fraction of the larger.

E.g., what is the area of a room 16ft. 6in. × 11ft. 4in.?

16 ft. 6 in. = $16\frac{1}{2}$ or $\frac{33}{2}$ ft.

and 11 ft. 4 in. = $11\frac{1}{3}$ or $\frac{34}{3}$ ft.

$\frac{33}{2}$ ft. × $\frac{34}{3}$ ft. = 187 sq. feet, the area required.

228. EXAMPLES XXV.

In the ten following examples write down the area—

1. 14 ft. × 17 ft.
2. 14 ft. 6 in. × 18 ft.
3. 9 ft. 3 in. × 8 ft. 4 in.
4. 5 miles 4 furlongs × 4 miles 160 yds.
5. 3 yds. 1 ft. × 1 pole
6. 5 ft. × 3 in.
7. 8 miles × $1\frac{1}{2}$ furlongs.
8. $3\frac{1}{2}$ ft. × $5\frac{1}{3}$ yds.
9. $3\frac{3}{4}$ ft. × $3\frac{1}{3}$ yds.
10. 4 yards 2 ft. 3 in. × 1 yd. 2 ft. 4 in.

In the ten following examples find the other side if—

11. The area is 35 sq. feet and one side 7 inches.
12. ,, 42 sq. yds. ,, 1 ft. 6 in.
13. ,, 28 acres ,, 7 poles
14. ,, 105 sq. miles ,, 3 miles 4 furlongs
15. ,, 63 sq. feet ,, 6 ft. 9 in.
16. ,, 121 sq. ft. 48 in. ,, 15 ft. 2 in.
17. ,, 3 sq. yds. 8 ft. ,, 2 yds. 1 ft.
18. ,, 33 sq. yds. $8\frac{1}{4}$ ft. ,, 2 yds. $2\frac{1}{4}$ ft.
19. ,, 7 ft. 12 in. ,, 4 ft. 3 in.
20. ,, 154 sq. poles ,, 5 poles 2 yds. 2 ft. 3 in.

Find the area of the following triangles:—

21. Base 13 ft. Altitude $5\frac{1}{2}$ ft.
22. ,, $3\frac{1}{2}$ ft. ,, $2\frac{1}{4}$ in.
23. ,, 7 miles ,, 4 furlongs
24. ,, 7 miles 1 furlong ,, $3\frac{1}{4}$ miles
25. ,, $5\frac{1}{4}$ in. ,, 1 ft. 4 in.
26. Three sides 5 ft., 4 ft., 3 ft.
27. ,, 13 yds., 14 yds., 15 yds.
28. ,, 20 in., 21 in., 29 in.
29. ,, 108 poles, 135 poles, 81 poles
30. ,, 13 in., 24 in., 13 in.

31. How many bricks 9 in. × $4\frac{1}{2}$ in. will it take to face a wall 90 yds. long by 18 ft. high?

32. How many bricks, showing only the small end, $4\frac{1}{2}$ in. × by $3\frac{1}{2}$ in. would it take to face a wall 90 yards long by 14 ft. high?

33. How many square tiles, $8\frac{1}{2}$ in. each way, will it take to pave a courtyard 85 yards by 119 yds.?

34. How many pieces are there in a Roman mosaic measuring 1 yd. square, if each piece measures $\frac{1}{4}$ in. × $\frac{1}{18}$ in.

35. How many square tiles 4 in. each way will it take to face a wall 29 yds. by 17 ft.?

36. What is the length of the perpendicular from the opposite angle to the longest side of the triangle whose sides are 5 ft., 5 ft., and 6 ft.

37. What is the length of the perpendicular from the opposite angle to the shortest side of the triangle whose sides are 13 in., 13 in., 10 in.?

38. What is the length of the perpendicular from the opposite angle to the longest side of the triangle whose sides are 6 ft., 10 ft. and 8 ft.?

39. What is the length of the rectangular area whose breadth is 56 yards, which is equal to the area of the rectangle 21 yds. × 32 yds.?

40. What is the side of a square which is equal in area to the rectangle 3 ft. × 48 ft.?

41. What is the area of a gravel path 6 ft. wide, which runs round a rectangular piece of grass 48 yds. × 32 yds.?

42. What is the area of a square grass plot which is surrounded by a gravel path 2 yards wide, if the outside measurement of the path is 176 yards?

43. How many turfs 4 ft. by 9 in. will it take to cover a cricket field 90 yds. by 80 yds.?

44. If it take 57,600 turfs (9 in. wide) to cover a cricket field 90 yds. by 80 yds., how long are they?

45. If it take 19,200 square tiles to cover a courtyard 40 yds. × 30 yds., find the length of a side of the tiles used.

46. How many soldiers are there in a hollow square, if they are 6 deep and there are 44 men in the outside rank on each side?

47. How many more soldiers would it require to add an additional row, outside the square in 46?

48. If in a hollow square 6 deep there are 624 men, how many are there on each side of the square?

49. If in a hollow square 6 deep it takes 112 more men to add on an extra row on each side inside, how many men are there on each side in the outside row?

50. Find the area of the triangle whose sides are 13 yds., $18\frac{3}{5}$ yds., $8\frac{1}{5}$ yds.

CHAPTER XXVI.

PRICE OF CARPETING AND PAPERING.

229. To find the area of the walls of a rectangular room, we must imagine the four sides opened out, when we shall see that the length of the area is twice (breadth + length) and its width the height of the room.

230. How many square yards of paper will it take to cover the four walls of a room 20 ft. × 16 ft. and 15 ft. high? We have to find the area of a rectangle 2 × 36 ft. long and 15 ft. broad, which gives us 1080 square feet or 120 square yards.

231. If we have to find the number of yards of carpet, say 2 ft. wide, to cover a given area, we must divide the area by the breadth; *e.g.*, how many yards of carpet 2 ft. wide will cover the floor of a room 27 ft. by 18 ft.? The answer is $\frac{27 \times 18}{2}$ ft. or $\frac{27 \times 18}{2 \times 3}$ *i.e.*, 81 yards.

232. Similarly, if asked to find how many yards of paper 2 ft. 3 in. wide it will take to paper the walls of a room 16 ft. × 14 ft. and 9 ft. high, our mental working is $\frac{2 \times 30 \times 9 \times 4}{9 \times 3}$ or 80 yards.

233. We could often write down the price of papering the walls or carpeting a room; *e.g.*, what will it cost to carpet a room 30 ft. × 27 ft. with carpet 2 ft. 3 in. wide at 5s. a yard? Our working is

$$£\frac{30 \times 27 \times 4}{9 \times 3 \times 4} \text{ or } £30.$$

234. We could also find the price of papering the room in 233 (its height being 10 ft.) with paper 2 ft. wide at 4d. a yard. Our working is

$$£\frac{2 \times 57 \times 10 \times 4}{2 \times 3 \times 12 \times 20} \text{ or } £3\ 3s.\ 4d.$$

235. Some of these questions if asked conversely can be worked mentally; *e.g.*, if it cost £8 to carpet a room 18 ft. long with a carpet 2 ft. 3 in. wide at 4s. a yard, how broad is the room? We see that there are 40 yards of carpet or $\frac{40 \times 3 \times 9}{4}$ square feet, and this divided by 18 gives us 15 ft.

236. The student is advised to practise keeping numbers like 3 × 5 × 8 in his memory in that form and not as 120.

237. EXAMPLES XXVI.

What is the area in feet and fractions of a foot of the ten following rooms?

1. 14 ft. × 16 ft. and 11 ft. high.
2. 17 ft. × 18 ft. 6 in. and 12 ft. high.
3. 15 ft. 3 in. × 14 ft. 4 in. and 12 ft. high.
4. 16 ft. 2 in. × 15 ft. 8 in. and 9 ft. high.
5. 10 ft. 6 in. × 8 ft. 3 in. and 7 ft. high.
6. 13 ft. 7 in. × 17 ft. 5 in. and 12 ft. high.
7. 15 ft. 2 in. × 14 ft. 3 in. and 11 ft. high.
8. 60 ft. × 30 ft. and 30 ft. high.
9. 21 ft. 7 in. × 19 ft. 3 in. and 13 ft. 6 in. high.
10. 33 ft. 5 in. × 14 ft. 9 in. and 12 ft. 3 in. high.

Find the cost of painting the walls of the ten following rooms at the price per square foot placed against each.

11. 15 ft. × 18 ft. and 10 ft. high at 1s.
12. 17 ft. 6 in. × 19 ft. 6 in. and 12 ft. high at 1s. 8d.
13. 14 ft. 8 in. × 17 ft. 4 in. and 11 ft. high at 2s.
14. 19 ft. 7 in. × 17 ft. 5 in. and 12 ft. 6 in. high at 4d.
15. 11 ft. 5 in. × 12 ft. 5 in. and 10 ft. high at 6d.
16. 17 ft. 3 in. × 19 ft. 6 in. and 12 ft. high at 8d.
17. 12 ft. 2 in. × 11 ft. 10 in. and 9 ft. 6 in. at 7d.
18. 17 ft. 3 in. × 13 ft. 6 in. and 10 ft. high at 11d.
19. 23 ft. × 17 ft. and 14 ft. high at 5½d.
20. 11 ft. × 9 ft. 6 in. and 9 ft. 6 in. high at 6d.

In the ten following rooms, find the number of yards of paper 2 ft. 3 in. wide required to cover the walls.

21. 17 ft. × 19 ft. and 15 ft. high.
22. 25 ft. × 29 ft. and 13 ft. high.
23. 21 ft. 6 in. × 23 ft. 6 in. and 15 ft. high.
24. 39 ft. 7 in. × 41 ft. 5 in. and 17 ft. high.
25. 22 ft. 4 in. × 31 ft. 8 in. and 13 ft. high.
26. 15 ft. 6 in. × 17 ft. 6 in. and 15 ft. high.
27. 31 ft. 6 in. × 21 ft. and 12 ft. high.
28. 100 ft. × 66 ft. 6 in. and 20 ft. high.
29. 17 ft. × 12 ft. 3 in. and 10 ft. high.
30. 15 ft. × 18 ft. 9 in. and 12 ft. 6 in. high.

In the five following rooms find the cost of carpeting their floors with carpet 2 ft. 3 in. wide, at the price per yard placed against each.

31. 12 ft. × 18 ft. at 2s. 6d. a yard.
32. 18 ft. × 15 ft. at 2s. a yard.
33. 13 ft. 6 in. × 16 ft. 6 in. at 4s. a yard.
34. 20 ft. × 14 ft. 3 in. at 2s. 3d. a yard.
35. 54½ ft. × 12 ft. 6 in. at 4s. 6d. a yard.

Find the cost of papering the following ten rooms with paper 27 in. wide at the price per yard placed against each.

36. 22 ft. × 32 ft. and 12 ft. high at 5d. a yard.
37. 35 ft. × 37 ft. and 15 ft. high at 1s. a yard.
38. 9 ft. × 11 ft. 3 in. and 8 ft. high at 3d. a yard.
39. 50 ft. 6 in. × 63 ft. 6 in. and 27 ft. high at 9d. a yard.
40. 11 ft. × 13 ft. and 9 ft. high at 6d. a yard.
41. 20 ft. × 28 ft. and 10 ft. high at 2s. 3d. a yard.
42. 20 ft. × 20 ft. 6 in. and 18 ft. high at 7d. a yard.
43. 15 ft. × 18 ft. 9 in. and 15 ft. high at 3d. a yard.
44. 20 ft. × 18 ft. 3 in. and 15 ft. high at 8d. a yard.
45. 17 ft. 9 in. × 22 ft. 9 in. and 12 ft. high at 11d. a yard.
46. If it cost £8 to carpet a room 15 ft. long with carpet 2 ft. 3 in. wide at 6s. a yard, how broad is it?
47. If it cost £6 10s. to carpet a room 20 ft. long with carpet 2 ft. 3 in. wide at 4s. 6d. a yard, how long is it?
48. If it cost £8 to paper a square room 18 ft. long with paper 2 ft. 3 in. wide at 1s. a yard, how high is it?
49. What will it cost to pave a courtyard 20 yds. × 30 yds. with tiles 8 in. square at 10s. a hundred?
50. What will it cost to pave a hall 24 ft. × 35 ft. with tiles 6 in. by 9 in. at 5s. a 100?

(To be continued.)

Easy Steps in Trigonometry.

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Author of 'Catch Questions in Arithmetic,' etc., etc.

ANSWERS AND HINTS TO SOLUTIONS.

CHAPTER XXIII.

1. $p_a a = 2\Delta \quad \therefore p_a = \frac{2\Delta}{a}$ &c.

$$\therefore \frac{p_a^2}{p_b p_c} = \frac{\frac{4\Delta^2}{a^2}}{\frac{4\Delta^2}{bc}} = \frac{bc}{a^2}$$

2. If $\frac{1}{b} - \frac{1}{a} = \frac{1}{c} - \frac{1}{b}$

$$\frac{2}{\sin B} = \frac{\sin A + \sin C}{\sin A . \sin C}$$

$$\frac{2}{2 \sin \frac{B}{2} \cos \frac{B}{2}} = \frac{2 \sin \frac{A+C}{2} \cos \frac{A-C}{2}}{\sin A . \sin C}$$

$$\sin A . \sin C = 2 \cos^2 \frac{B}{2} . \cos \frac{A+C}{2} \cos \frac{A-C}{2}$$

$$= \cos^2 \frac{B}{2} (\cos A + \cos C) \text{ etc.}$$

3. The student is recommended to draw a large figure.

ABP_1 is a right angle (being the angle in a semicircle), and $AP_1 = AB \sin ABP_1$, but $ABP_1 = \frac{1}{2} P_1CA = \frac{1}{2}(\pi - \theta)$

$\therefore AP_1 = 2 \sin \frac{1}{2}(\pi - \theta) = 2 \cos \frac{\theta}{2} = x + \frac{1}{x}$ by our supposition.

But if $2 \cos \frac{\theta}{2} = x + \frac{1}{x}$;

$2 \cos \frac{n\theta}{2} = x^n + \frac{1}{x^n}$ (see Ch. 20, Ex. 9)

And $AP_n = AB \sin P_nBA = 2 \sin \frac{1}{2} P_nCA$

$= 2 \sin \frac{1}{2}(\pi - n\theta) = 2 \cos \frac{n\theta}{2}$

$\therefore AP_n = x^n + \frac{1}{x^n}$

4. $\tan 2\theta - \tan \theta = \frac{\sin(2\theta - \theta)}{\cos 2\theta \cdot \cos \theta}$

$= \sin \theta \cdot \sec \theta \cdot \sec 2\theta$

$\tan 3\theta - \tan 2\theta = \frac{\sin(3\theta - 2\theta)}{\cos 3\theta \cdot \cos 2\theta}$

$= \sin \theta \cdot \sec 2\theta \cdot \sec 3\theta$

&c., = &c.

$\tan n\theta - \tan(n-1)\theta = \sin \theta \cdot \sec(n-1)\theta \cdot \sec n\theta$

$\therefore \tan n\theta - \tan \theta = \sin \theta [\sec \theta \sec 2\theta + \ldots]$

or sum required $= \frac{\tan n\theta - \tan \theta}{\sin \theta}$

5. $\operatorname{Cot} \frac{1}{2}\theta - \cot \theta = \frac{\cos \frac{1}{2}\theta \cdot \sin \theta - \cos \theta \sin \frac{1}{2}\theta}{\sin \frac{1}{2}\theta \cdot \sin \theta}$

$= \frac{1}{\sin \theta} = \operatorname{cosec} \theta.$

$\cot \theta - \cot 2\theta = \operatorname{cosec} 2\theta$

$\cot 2\theta - \cot 4\theta = \operatorname{cosec} 4\theta$

&c., = &c.

$\therefore \cot \frac{1}{2}\theta - \cot 2^{n-1}\theta =$ sum required.

6. $\operatorname{Cot} \frac{1}{2}\theta - \tan \frac{1}{2}\theta = 2 \cot \theta$

$\frac{1}{2} \cot \frac{1}{2}\theta - \frac{1}{2} \tan \frac{1}{2}\theta = \cot \theta$

$\therefore \frac{1}{2} \tan \frac{1}{2}\theta = \frac{1}{2} \cot \frac{1}{2}\theta - \cot \theta$

and $\frac{1}{4} \tan \frac{1}{4}\theta = \frac{1}{4} \cot \frac{1}{4}\theta - \frac{1}{2} \cot \frac{1}{2}\theta$

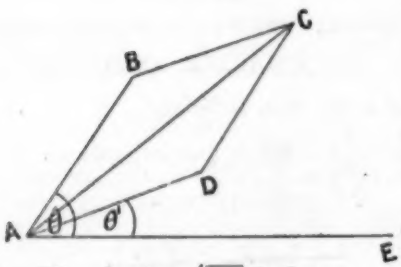
&c., = &c.

$\therefore$ sum to infinity $= \frac{1}{2^n} \cot \frac{\theta}{2^n} - \cot \theta$, where n is infinitely large and this is

$= \frac{1}{\theta}\left(\frac{\theta}{2^n} + \tan \frac{\theta}{2^n}\right) - \cot \theta$

$= \frac{1}{\theta} - \cot \theta$ (see 217).

7.



$AB = DC = [\cos \theta + \sqrt{-1} \sin \theta] r$

$AD = BC = [\cos \theta^1 + \sqrt{-1} \sin \theta^1] r_1$

$\therefore AC = AB + AD = (r \cos \theta + r_1 \cos \theta^1) + \sqrt{-1}\,(r \sin \theta + r_1 \sin \theta^1)$

which represents a line, whose length is

$\sqrt{[(r \cos \theta + r_1 \cos \theta^1)^2 + (r \sin \theta + r_1 \sin \theta^1)^2]}$

or $\sqrt{[r^2 + r_1^2 + 2rr_1 \cos(\theta - \theta^1)]}$

and it is inclined to the initial line at an angle of

$\tan^{-1} \frac{r \sin \theta + r_1 \sin \theta^1}{r \cos \theta + r_1 \cos \theta^1}$

8. Perpendiculars on sides measuring 13, 14, and 15 in. are $12\frac{1}{13}$, 12, $11\frac{1}{5}$ in. respectively.

9. $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

$\therefore \frac{\sin A + \sin B + \sin C}{a + b + c} = \frac{\sin A}{a}$

$\frac{4 \cos \frac{A}{2} \cdot \cos \frac{B}{2} \cdot \cos \frac{C}{2}}{a + b + c} = \frac{\sin A \cdot bc}{abc}$

$\therefore \frac{2abc}{a + b + c} \cos \frac{A}{2} \cdot \cos \frac{B}{2} \cdot \cos \frac{C}{2} = \frac{1}{2} bc \sin A.$

10. $\frac{1 + \cos(A - B)\cos C}{1 + \cos(A - C)\cos B} = \frac{2 - 2\cos(A - B)\cos(A + B)}{2 - 2\cos(A - C)\cos(A + C)}$

$= \frac{1 - \cos 2A + 1 - \cos 2B}{1 - \cos 2A + 1 - \cos 2C}$

$= \frac{\sin^2 A + \sin^2 B}{\sin^2 A + \sin^2 C}$

$= \frac{a^2 + b^2}{a^2 - c^2}$

11. Use formula in 301. Ans. 84 sq. units.

12. Let DEH or DHE or IHN or HIM $= \theta$.

Let EI $= i$, ED or DH $= h$, and ND $= n$, HN $= (n - h)$

Then EH $= 2h \cos \theta$

HI $= i - 2h \cos \theta$

(ED + IM) $= i \cos \theta$

$IN^2 = (i - 2h \cos \theta)^2 + (n - h)^2 - 2(i - 2h \cos \theta)(n - h) \cos \theta.$

Expanding, cancelling, and substituting $4nh$ for i^2, and $i^2 \cos^2 \theta$ for $4nh \cos^2 \theta$, we get

$IN^2 = (n + h)^2 - 2(n + h) i \cos \theta + i^2 \cos^2 \theta$

$\therefore IN = n + h - i \cos \theta$

$= ND + h - h - IM$

$\therefore ND = IN + IM.$

13. In the triangle NA'H the angle $A'HN = \pi - \theta$

$\therefore \cos A'HN = -\cos \theta$, hence as in 12.

14. (i.) $BCE = BAE = \frac{A}{2}$ and $BCI = \frac{C}{2}$

$\therefore ECI = \frac{A + C}{2}$

and $EIC = IAC + ACI$ or $\frac{A + C}{2}$

$\therefore EI = EC$ and $EC = EF \sin EFC$ or $2R \sin \frac{A}{2}$

(ii.) $IA = IM \operatorname{cosec} \frac{A}{2} = r \operatorname{cosec} \frac{A}{2}.$

(iii.) $(R - OI)(R + OI) = RI \cdot IQ = AI \cdot IE$, Euc. III. 35.

$= r \operatorname{cosec} \frac{A}{2} \cdot 2R \sin \frac{A}{2}$

$= 2rR$ see also Chap. XII. Ex. 1.

(iv.) $DE = EC \sin \frac{A}{2} = 2R \sin^2 \frac{A}{2}.$

15. Because R is the middle point of hypotenuse of PGC

$\therefore RP = RG$ and $RPG = RGP$

Similarly $QPG = QGP$

$\therefore QPR$ or $WPX = QGR$

$\therefore WPX = 180° - WSX$ $\therefore$ QSR and QGR are supplementary and a circle passing through SQR would pass through G.

Again PQDR is a parallelogram

$\therefore QDR = QPR = QGR$

$\therefore$ a circle passing through QRG would pass through D, etc., etc.

16. If a line were drawn through the middle point of LV at right angles to it, it would bisect OP, and the centre of the nine point circle is in this straight line, again if a line were drawn through the middle point of DG and at right angles to it, it would also bisect OP, but the centre of the nine point circle is in this line also $\therefore$ etc.

17. Since the sides of the triangle QSR are respectively half of the sides of the triangle BAC, the radius of the circle described about the former circle is half that described about the latter.

18. Since DGS is a right angle DS is a diameter of the nine point circle and ∴ = OA but DO is parallel to GA ∴ etc.

19. Since OA is parallel to DS
∴ OAH = AHS = DHE
but OEA = OAE ∴ etc.

20. EI = EC (see Ex. 14.) $= 2R \sin \frac{A}{2}$

$$\therefore EI^2 = 4R^2 \sin^2 \frac{A}{2}$$

$$DH = DE = EC \sin \frac{A}{2} = 2R \sin^2 \frac{A}{2}$$

and $DN = \frac{1}{2} DS = \frac{1}{2} R$

$$\therefore 4\, DH \cdot DN = 4\, R^2 \sin^2 \frac{A}{2} \quad \therefore \text{ etc.}$$

21. In Ex. 12 we proved that if $EI^2 = 4\, DH \cdot DN$
ND = NI + IM
But ND is the radius of the nine point circle and IM is the radius of the inscribed circle, ∴ the nine point circle touches the inscribed circle at the point where IN produced cuts the two circles at the point where they touch one another.

22. Since EI, EA′ and EC are all equal, the angle ICA′ is a right angle.
Similarly, if EB and BI were joined we could prove EBI is a right angle hence A′ is the centre of the escribed circle.

23. $EA' = EC = 2\, R \sin \frac{A}{2}$

$$\therefore EA'^2 = 4\, R^2 \sin^2 \frac{A}{2}$$

hence as in 20.

24. In 13 we proved that if $EA'^2 = 4\, DH \cdot DN$, ND = NA′ − A′M′, hence NA′ will cut the circles of which ND and A′M′ are the radii in the point where they touch one another.

25. In the triangle ABD the angle BAD contains 36°. Let AM bisect it.
Since $AB \cdot BC = AC^2$ or BD^2

$$\therefore AC : AB = \sqrt{5} - 1 : 2$$

$$\sin 18^\circ = \frac{BM}{AB} = \frac{1}{2} \cdot \frac{AC}{AB} = \frac{\sqrt{5} - 1}{4}$$

$$\cos 18^\circ = \sqrt{1 - \frac{6 - 2\sqrt{5}}{16}} = \frac{\sqrt{10 + 2\sqrt{5}}}{4}$$

&c., &c.

From C draw CN perpendicular to AD

$$\cos 36^\circ = \frac{1}{2} \frac{AB}{CA} = \frac{2}{2(\sqrt{5} - 1)} = \frac{1}{\sqrt{5} - 1} = \frac{\sqrt{5} + 1}{4}$$

CHAPTER XXIV.

EXAMINATION QUESTIONS.

311. These examples are very nearly all of them taken from recent examination papers, as set by the different Boards of Examiners at Oxford, Cambridge, Dublin, Woolwich, &c. Any explanations required will be found in the Answers and Hints.

312. Next month, a collection of more difficult examples will be given, which, with a set of questions on book work, will complete the series of papers.

313. EXAMPLES XXIV.

1. Trace the changes in sign and magnitude of the expression
sin (π sin x) as x increases from 0 to 2π.

2. Express the angle 44° as a fraction of the angle 1·5 circular measure. ($\pi = 3\frac{1}{7}$)

3. Prove $1 - \tan^2 x \tan^2 y = \frac{\cos^2 y \sin^2 x}{\cos^2 x \cos^2 y}$.

4. Show that the distances of A, one of the angular points of a regular octagon ABCDEFH, from the sides BC, CD, DE respectively, are in the ratio $1 : 1 + \sqrt{2} : 2 + \sqrt{2}$.

5. Prove that to turn circular measure into seconds we must multiply by 206,265, and to turn seconds into circular measure we must multiply by ·0000048.

6. Find the number of sides in a polygon when there are as many degrees in the sum of its angles as there are grades in the sum of the angles of a polygon, which has one side fewer than the former.

7. How many degrees and minutes are there in the angle whose circular measure is ·24?

8. The tangent of an angle is $\frac{1}{2}$; find the other trigonometrical ratios.

9. Prove that $\cos 15^\circ - \sin 15^\circ = \frac{1}{\sqrt{2}}$

10. OA, OB are radii of a circle at right angles to one another, tangents to the circle at A and B meet a radius OP produced in T and t; prove that AT, OT, Bt, Ot, are proportional to the tangent, secant, cotangent, and cosecant, of the angle AOP.

11. Prove that $2 \cot 2A = \cot A - \tan A$.

12. Prove that $\cot (A + 15^\circ) - \tan (A - 15) = \frac{4 \cos 2A}{2 \sin 2A + 1}$

13. Show that $8 (\sin^4 \theta - \sin^2 \theta) + 1 = \cos 4\theta$

14. Prove that $\tan \frac{\theta}{2} = \sqrt{\frac{1 - \cos \theta}{1 + \cos \theta}}$

15. Prove that $\sin^2 2A = 2 \cos^2 A (1 - \cos 2A)$

16. Prove that $\tan 6\theta = \frac{\cos 5\theta - \cos 7\theta}{\sin 7\theta - \sin 5\theta}$

17. If $\frac{a}{b} = \frac{\cos A}{\cos B}$; prove that

$$a \tan A + b \tan B = (a + b) \tan \frac{A + B}{2}$$

18. Prove that $\cot \frac{\pi}{8} - \tan \frac{\pi}{8} = 2$.

19. Prove that $\frac{1 + \tan 2A \tan A}{\tan A + \cot A} = \frac{1}{2} \tan 2A$.

20. Prove that $\frac{\cot \frac{A}{2}}{\cot A} = 1 + \sec A$.

21. Prove that $\frac{\tan 5\theta + \tan 3\theta}{\tan 5\theta - \tan 3\theta} = 4 \cos 2\theta \cos 4\theta$.

22. Solve the simultaneous equations:

$$\left.\begin{aligned} \cos (2x + 3y) &= \tfrac{1}{2} \\ \cos (3x + 2y) &= \tfrac{\sqrt{3}}{2} \end{aligned}\right\}.$$

23. Prove that $\sin A (\cos 2A + \cos 4A + \cos 6A) = \sin 3A \cos 4A$.

24. Prove that $\frac{\sin \theta}{\cos \theta + \sin \phi} + \frac{\sin \phi}{\cos \phi - \sin \theta} = \frac{\sin \theta}{\cos \theta - \sin \phi} + \frac{\sin \phi}{\cos \phi + \sin \theta}$.

25. Prove that $\frac{\sin 2A + \sin 4A}{\cos 2A - \cos 4A} = \cot A$.

26. Prove that $(\sin 2A - \sin 2B) \tan (A + B) = 2 (\sin^2 A - \sin^2 B)$.

27. Prove that $\frac{\sin A + \sin 3A + \sin 5A + \sin 7A}{\cos A + \cos 3A + \cos 5A + \cos 7A} = \tan 4A$.

28. Prove that $\left\{1 + \sqrt{2}\sin\left(\frac{\pi}{4} - x\right)\right\}^2 = 4\cos^2\frac{x}{2}\left(1 - \sin x\right)$.

29. Prove that $\sin^2\theta \sin 3\theta + \cos^2\theta \cos 3\theta = \cos^2 2\theta$.

30. Prove that $\cos\theta - 2\cos 5\theta + \cos 9\theta = 2\sin 2\theta\,(\sin 3\theta - \sin 7\theta)$.

31. Prove that $\sin^{-1}\frac{3}{5} - \sin^{-1}\frac{5}{13} = \sin^{-1}\frac{16}{65}$.

32. Prove that $\tan^{-1}\frac{1}{2} + \sin^{-1}\frac{1}{\sqrt{5}} = 45°$.

33. Prove that $2\sin^{-1}\frac{1}{3} = \cos^{-1}\frac{7}{9}$.

34. Prove that $\cot^{-1}\sqrt{3} - \cot^{-1}(\sqrt{3} + 2) = \frac{\pi}{12}$.

35. Prove that $2\tan^{-1}\frac{1}{3} + \tan^{-1}\frac{1}{7} = \tan^{-1}\frac{1}{2}$.

36. Prove that $\sin^{-1}\frac{3}{5} + \sin^{-1}\frac{5}{13} = \text{vers}^{-1}\frac{33}{65}$.

37. Prove that $\cot^{-1}\frac{1}{2} + \cot^{-1}\frac{1}{3} - \cot^{-1}\frac{1}{2 + \sqrt{3}} = \frac{\pi}{3}$.

38. Prove that $\tan^{-1} t + \tan^{-1}\frac{2t}{1 - t^2} = \tan^{-1}\frac{3t - t^3}{1 - 3t^2}$.

39. Prove that $\cot^{-1} 2 + \cot^{-1} 4 = \cot^{-1} 3 + \cot^{-1} 5 + \cot^{-1} 7 + \cot^{-1} 21$.

40. Prove that $\tan^{-1}\frac{1}{10} + \text{vers}^{-1}\frac{\sqrt{202} - 11}{\sqrt{202}} = \frac{\pi}{4}$

41. Find all the values of θ which satisty $4\cos\theta - 3\sec\theta = 2\tan\theta$.

42. Solve the equation $\tan^2\theta - (1 + \sqrt{3})\tan\theta + \sqrt{3} = 0$.

43. Given $\sin 4\theta + 4\sin 3\theta\cos\theta = 0$ Find $\tan\theta$.

44. Solve $2\tan^2\theta = \sec^2\theta$.

45. Find all the angles less than 180° which satisfy the equation $12(\cos^2 2A + \sec^2 2A) = 25$

46. Find all the values of x which satisfy the equation $\cos(x + 30°) = \cos(2x + 45°)$.

47. Solve the equation $\cot 2\theta - \cot\theta + \frac{2}{\sqrt{3}} = 0$.

48. Find all the values of θ which satisfy the equation $\tan\theta + \cos 2\theta = 1$.

49. Solve $\tan^2\theta + 4\sin^2\theta = 3$.

50. Solve $\cot^2\theta + \tan^2\theta = 10$.

51. Two adjacent sides of a parallelogram 5 in., 8 in. long respectively, include an angle of 60°. Find the lengths of the two diagonals, and the area of the figure.

52. The lengths of two of the sides of a triangle are 1 foot and $\sqrt{2}$ feet respectively, and the angle opposite to the shorter side is 30°. Prove that there are two triangles which satisfy these conditions; find their angles, and show that their areas are in the ratio of $\sqrt{3} + 1 : \sqrt{3} - 1$.

53. If B = 45°, C = 60° and if $a = 2(\sqrt{3} + 1)$ in., prove that the area of the triangle is $(6 + 2\sqrt{3})$ sq. in.

54. Explain what measurements have to be made at two stations A and B, in order to find the distance CD between two inaccessible objects, ABCD being in one plane.

55. Find the height of a staff, the length of whose shadow on the ground is 20 feet, when the elevation of the sun above the horizon is 30°.

56. A person wishing to know the height of a spire from the tower found that if he stood so that his eye was in the same horizontal plane and at a distance of 1,200 yds. from the centre of the base of the spire, a pencil, 2 inches long at a distance of 6 feet from his eye, exactly covered the spire. How did he calculate its height?

57. Find approximately the number of minutes denoting the inclination to the horizon of an incline which rises $5\frac{1}{2}$ feet in 420 yds. ($\pi = \frac{22}{7}$).

58. The sine of the greatest angle of a triangle is $\frac{\sqrt{3}}{2}$, and the difference between the greatest and the least is 100°. Find all the angles.

59. Two posts on the bank of a river are observed from the opposite bank. When the observer stands immediately opposite to one of the posts they subtend an angle of 60°, when he has walked 20 yards directly away from the river they subtend an angle of 45°. Find the breadth of the river and the distance of the posts apart.

60. In the triangle, whose sides are 3, 4, $\sqrt{38}$ units in length respectively, prove, without using tables, that the largest angle is greater than 120°.

61. Taking the sun's mean apparent diameter as subtending an angle of $31\frac{1}{2}'$ and its distance from the earth as 94 millions of miles, find approximately the radius of the sun (neglecting the size of the earth, and letting $\pi = \frac{22}{7}$).

62. If the sun's distance from the earth be taken as 24,000 times the earth's radius, find (in seconds) the earth's apparent diameter as seen from the sun.

63. A flagstaff 25 feet high is fixed on the top of a vertical bank 15 feet high, which is close to the side of a road. At a point directly opposite on the other side of the road the flagstaff and bank subtend equal angles. Find the width of the road.

64. The sides of a triangle are 10, 15, and 20; find the radius (R) of the circumscribing circle, and the ratio of its area to that of the triangle.

65. Prove that in any triangle $2a\cos\frac{B}{2}\cos\frac{C}{2}\operatorname{cosec}\frac{A}{2} = a + b + c$.

66. The area of a triangle $= \frac{1}{2}a^2\operatorname{cosec} A(\cos A + \cos B\cos C)$.

67. Prove that in any triangle $a\sin(B - C) + b\sin(C - A) + c\sin(A - B) = 0$.

68. $4\left(bc\cos^2\frac{A}{2} + ca\cos^2\frac{B}{2} + ab\cos^2\frac{C}{2}\right) = (a + b + c)^2$.

69. Prove that $2R = \frac{abc}{2\,(\text{area of triangle})}$

70. Prove that the area of any triangle $= a^2\frac{\cos(B - C) + \cos A}{4\sin A}$.

71. Prove that $2R = \frac{a + b + c}{\sin A + \sin B + \sin C}$.

72. If d_1, d_2, d_3 be the distances of the centre of the inscribed triangle from the angular points A, B, C respectively, prove that $\frac{d_1^2}{bc} + \frac{d_2^2}{ca} + \frac{d_3^2}{ab} = 1$.

73. If in a triangle $a\cos A = b\cos B$, prove that the triangle is either isosceles or right angled.

74. Prove that in any triangle $\frac{\cos\frac{1}{2}(A - B)}{\cos\frac{1}{2}(A + B)} = \frac{a + b}{c}$.

75. If in a triangle the bisector of the base c is perpendicular to the side b, prove that $2\tan A + \tan C = 0$.

76. If in a triangle C = 60°, prove that $\frac{1}{a + c} + \frac{1}{b + c} = \frac{3}{a + b + c}$.

77. If D, E, F be the feet of the perpendiculars from A, B, and C upon the opposite sides, prove that the diameters of the circles circumscribing AEF, BDF, and CDE are respectively $a \cot A$, $b \cot B$, and $c \cot C$.

78. Prove that in any triangle

$$\cos A + \cos B = \frac{2(a+b)}{c} \sin^2 \tfrac{1}{2} C.$$

79. If R, r_a, r_b, r_c are the radii of circles described and escribed, show that

$$Rr_a(s-a) = Rr_b(s-b) = Rr_c(s-c).$$

80. If A, B, C be the angles of a triangle

$$\cos\left(A + \frac{B}{2}\right) + \cos\left(B + \frac{C}{2}\right) + \cos\left(C + \frac{A}{2}\right) = \sin\frac{A-B}{2} + \sin\frac{B-C}{2} + \sin\frac{C-A}{2}$$

In some of the following Examples logarithms will be required: they must be obtained from tables.

81. In the triangle ABC, $a = 13$, $b = 7$, $C = 60°$, find A and B.

82. If $a = 32$, $b = 40$, $c = 66$, find the angle C.

83. A ship sailing due north observes two lighthouses bearing respectively N.E. and N.N.E. After sailing 20 miles the lighthouses are seen to be in a line due east. Find the number of miles between the lighthouses accurately to 4 places of decimals.

84. From each of two ships a mile apart the angle is observed which is subtended by the other ship and a beacon on shore; these angles are found to be 52° 25′ 15″ and 75° 9′ 30″ respectively. Find the distances of the beacon from each of the ships, one distance exact, and the other to five places of decimals.

85. A man who is walking on a level plain towards a tower observes at a certain point that the elevation of the top of the tower is 10°, and after going 50 yds. nearer to the tower that the elevation is 15°. Find the height of the tower in yards to four places of decimals.

86. Given that $a = 250$, $b = 240$, $A = 72° 4' 48''$. Find B and C.

87. A lighthouse appears to a man in a boat 300 yds. from its base to subtend an angle of 6° 20′ 24·7″. Find in feet the height of the lighthouse.

88. Two sides of a triangle are 9 and 7 and the included angle is 38° 56′ 32·8″. Find the remaining side and angles.

89. Standing at a certain point I observe the elevation of a house is 50° 15′ and that the sill of one of its windows, known to be 20 feet above the ground, subtends an angle of 20° at the same point: show that the height of the house is nearly 22 yards.

90. The sides of a triangular field are 330 yds., 275 yds., 275 yds.: find its area in acres.

91. A man observes that when he has walked c feet up an inclined plane, the angular depression of an object in the horizontal plane through the foot of the slope is α; and that, when he has walked a further distance of c feet, the angular depression of the same object is β. Show that the inclination of the slope to the horizon is $\cot^{-1}(2 \cot \beta - \cot \alpha)$.

92. If perpendiculars be drawn from the angular points of a triangle on the opposite sides and meet in P (called the ortho centre), prove that

$$\frac{\text{Sin A}}{a} = \frac{\text{Cos A}}{\text{AP}}.$$

93. If p, q are the perpendiculars from A, B on any straight line drawn through C of a triangle, prove that

$$a^2p^2 + b^2q^2 - 2abpq \cos c = a^2b^2 \sin^2 c.$$

94. Prove that in any triangle

$$\tan 2A + \tan 2B + \tan 2C = \tan 2A \tan 2B \tan 2C.$$

95. If D, E, F, be the feet of the perpendiculars from A, B, C, on opposite side of a triangle, prove that radius of circle inscribed in triangle DEF $= 2R \cos A \cdot \cos B \cos C$ (R = the radius of circle described about ABC).

96. Show that if the value of tan A be given, nothing else being known about the angle A, there are four values of $\sin \frac{A}{2}$ and explain why the sum of the squares of those values is 2.

97. From a point A on a level plain the angle of elevation of a kite is $\alpha°$ and its direction south; and from a place B which is c yards south of A on the same plain, the kite is seen northwards at an angle of elevation $\beta°$. Find the distance of the kite from A and its height above the ground.

98. ABCDE is a regular pentagon: join BD, CE, cutting in F; and show that BAEF is a parallelogram whose angles are in the ratio of 2 : 3.

99. A polygon of n sides inscribed in a circle is such that its sides subtend angles α, 2α, $3\alpha \ldots n\alpha$ at the centre; show that the ratio of the area of this polygon to the area of the regular inscribed polygon of n sides is $\sin \frac{n\alpha}{2} : n \sin \frac{\alpha}{2}$.

100. If α, β, γ be the ratios which the sides a, b, c, of a triangle bear to the perpendiculars on them from the opposite angles A, B, C; prove

$$\alpha^2 + \beta^2 + \gamma^2 - 2(\alpha\beta + \beta\gamma + \gamma\alpha) + 4 = 0.$$

(To be continued.)

Quarterly Arithmetical Tests.

STANDARD I.—FIRST QUARTER.

1. 406
   73
   250
   4
   18

2. 576
   13

3. 908
   402

4. 8×2;
   12×3;
   6×4.

SECOND QUARTER.

1. 35
   7
   692
   8
   754

2. 614
   509

3. 327
   273

4. 3×3;
   10×4;
   5×6.

THIRD QUARTER.

1. 9
   805
   47
   300
   62

2. 405
   86

3. 710
   634

4. 9×4;
   4×5;
   8×6.

STANDARD II.—FIRST QUARTER.

1. 58,309
   6,074
   912
   86
   5

2. From 26,011 take 19,457.

3. 48,706 × 29.

4. 9×8; 7×9; 12×12.

SECOND QUARTER.

1. Subtract 59,095 from 64,046.

2. 37,648 × 175.

3. What is the sixth part of fifty-four thousand five hundred and thirty.

4. 27d.; 46d.; 79d.

THIRD QUARTER.

1. From 60,030 take 964.

2. 59,703 × 680.

3. 89,073 ÷ 9.

4. 105d.; 128d.; 141d.

STANDARD III.—FIRST QUARTER.

1. Divide 78,336 by 17.

2. How often is seventy-nine contained in four hundred and sixty-two thousand nine hundred and forty?

3. Find the eight hundred and sixteenth part of seven million seventeen thousand seven hundred.

4. A farmer had 700 sheep. He sold 45 every week for 13 weeks. How many had he left?

SECOND QUARTER.

1. If there were 18 baskets of apples, and each basket contained 75, and they were divided among 135 boys, how many would each boy get?

2. Seven hundred and four pounds eighteen shillings and five pence three farthings + sixteen pounds sixteen shillings and six pence farthing + ten thousand and thirty-nine pounds eleven shillings and eleven pence + forty pounds nineteen shillings and ten pence halfpenny + one hundred and twenty-three pounds thirteen shillings and eight pence three farthings.

3. Take fifteen thousand six hundred and nine pounds fourteen shillings and tenpence farthing from one hundred and twelve thousand one hundred pounds and eight pence three farthings.

4. A farmer exchanged a horse worth 59 guineas for a cow and £27 15s. What was the value of the cow?

THIRD QUARTER.

1. £3,047 19s. 8¼d. + £926 5s. 4½d. + £2,806 18s. 10¾d. + £13 4s. 9¼d. + £9 17s. 6¾d. + £50 3s. 11½d. + £8,651 11s. 2¾d.

2. A man sold half of his estate for thirty-five thousand seven hundred and eighty-six pounds at fifty-eight pounds an acre; what was the size of the estate?

3. How much less is nine thousand eight hundred and seventy-six pounds thirteen shillings and three farthings, than ten thousand pounds and a halfpenny?

4. If I bought 58 buns and 90 oranges at a penny each, what change would I receive out of a sovereign?

STANDARD IV.—FIRST QUARTER.

1. Multiply £73 15s. 8¾d. by 54.

2. How much is six hundred and nine times nineteen shillings and seven pence farthing?

3. Divide fifty-seven thousand and sixteen pounds and eleven pence halfpenny by twelve.

4. What is the ninety-seventh part of £47,327 4s. 3¾d.?

SECOND QUARTER.

1. Reduce seventeen thousand farthings to pounds.

2. Reduce 7 cwt. 3 qrs. 1 st. 13 lbs. to ounces.

3. How many quarters, &c., are there in three million thirty thousand three hundred pints of corn?

4. How much would 9 boys earn in a month (Sundays excepted) at 9½d. a day?

THIRD QUARTER.

1. How many rulers 9 inches long could be made from 5 furlongs?

2. How many seconds are there in September, October, and November?

3. Reduce two hundred and six thousand and sixteen sheets of paper to reams and quires.

4. A woman went shopping with a sovereign. She bought 10 yards of calico at 9d. per yard, and spent the rest in flannel at 1s. 3d. a yard. How many yards of flannel did she buy?

STANDARD V.—FIRST QUARTER.

1. Find the cost (by practice) of 17 pieces of cloth, each containing 82 yards, at 11s. 11½d. per yard.

2. How much is 10 lbs. 7 oz. 12 dwt. 20 grs. of gold worth at forty guineas a pound?

3. A farm of 978 acres is let at £1 18s. 6d. per acre; find the amount of half-a-year's rent.

4. Find the amount for 38 days 14 hours 48 minutes, at 5 guineas per day of 24 hours.

SECOND QUARTER.

1. If I pay £25 4s. income tax at 7d. in the pound, what is my income?

2. Make out an invoice for the following goods:—
276 lead pencils at ½d. each;
105 lead pencils at 10d. per dozen;
1,900 slate pencils at 5d. per 100;
390 pencil holders at 3d. per dozen;
725 penholders at 1s. 3d. per 100;

3. What is the cost of 6,549$\frac{2}{11}$ tons, at £53 13s. 7¾d. per ton?

4. If a garrison of 560 men have provisions for 27 days, how long would the provisions last, if increased by 70 men?

THIRD QUARTER.

1. A ship was owned by three men. The first owned $\frac{1}{6}$, and the second $\frac{3}{8}$. What did the third own?

2. If a man earn £409 10s. in 3 years of 52 weeks each, how much would he earn in 19 weeks?

3. In the following there are 3 fractions of equal value, find them and add them together:—
$\frac{2}{8}$, $\frac{1}{4}$, $\frac{3}{12}$, $\frac{5}{20}$, $\frac{5}{10}$.

4. A house and garden cost £678. If the house cost 8 times as much as the garden, what was the value of each?

STANDARD VI.—FIRST QUARTER.

1. Which is the greatest and the least of:—
$\frac{7}{11}$, $\frac{8}{15}$, $\frac{13}{23}$, and $\frac{9}{10}$?

2. What number multiplied by $\frac{3}{5}$ of $\frac{4}{7}$ of $3\frac{1}{2}$ will produce $1\frac{3}{4}$?

3. Simplify:—$\{(200 \div 2{\cdot}5) \div {\cdot}25\} \div {\cdot}025$.

4. Multiply $8{\cdot}14$ by $\dot{\cdot}5\dot{4}$.

SECOND QUARTER.

1. What is the value of $4{\cdot}75$ of 9 guineas?

2. Find the difference between $\frac{5}{7}$ of 4s. $4\frac{1}{2}$d. and and $1\frac{1}{11}$ of 3s. $2\frac{1}{2}$d., and reduce the result to the decimal of 4s.

3. A man owes his creditors £346 10s., and has only £32 9s. $8\frac{1}{4}$d. to pay them. How much is that in the pound?

4. A rope is $\dot{\cdot}01704\dot{5}$ of a mile in length. Give its length in inches.

THIRD QUARTER.

1. What is the amount of £765 for $3\frac{1}{4}$ years at $5\frac{1}{2}$ per cent.?

2. At what rate per cent. will £20 become £40 in 15 years?

3. If a lady spend $\cdot28$ of her income on clothes, $\cdot13$ on servants, $\cdot37$ on food, and save £77, what is her income?

4. What sum of money lent at $4\frac{1}{2}$ per cent. will gain £35 6s. 6d. in the year?

STANDARD VII.—FIRST QUARTER.

1. If 14 bricklayers, working 10 hours a day for 15 days, use 260,000 bricks, how many bricks would 20 bricklayers use in 7 days, working 9 hours a day?

2. Divide $\cdot70\dot{6}5$ by $6{\cdot}79$ to 6 places of decimals.

3. If a playground, 20 yards by 56 feet, be paved for 12 guineas, what will it cost for one which measures 110 feet by 28 yards?

4. In what time will the interest on £470 amount to £34 7s. $4\frac{1}{2}$d. at $3\frac{1}{4}$ per cent.?

SECOND QUARTER.

1. What is the difference between the true and banker's discount on a bill of £223 2s. 6d., due in 6 months at 4 per cent.?

2. Find decimally the average of $6\frac{1}{2}$, $21\frac{1}{2}$, $4\frac{3}{5}$, $\cdot0435$, and $1\frac{3}{4}$.

3. The present worth of a bill due in $1\frac{1}{2}$ years at $2\frac{1}{2}$ per cent. is £384 13s. 4d.; what is the amount of the bill?

4. In a dictation exercise given to a class of 42 boys, $\frac{1}{3}$ had no mistakes, $\frac{1}{7}$ had one each, $\frac{2}{7}$ had two each, $\frac{1}{14}$ had three each, and the remainder had four each. Find the *average* number of errors.

THIRD QUARTER.

1. Two schools are examined. One has 114 passes out of 120, and the other has 189 out of 210. By how much per cent. is one greater than the other?

2. Find the compound interest on £1,562 10s. for 3 years at 4 per cent.

3. What amount will be obtained by selling £8,975 stock in the Three per Cents. at $89\frac{1}{8}$, brokerage $\frac{1}{8}$ per cent.?

4. If 5 lbs. of tea at 2s. 8d. per lb. be mixed with 3 lbs. at 2s. 6d. per lb., at what price per lb. must the mixture be sold to gain $11\frac{1}{9}$ per cent.?

ANSWERS.

STANDARD I.

	First.	Second.	Third.
1.	751.	1,496.	1,223.
2.	563.	105.	319.
3.	506.	54.	76.
4.	16; 36; 24.	9; 40; 30.	36; 20; 48.

STANDARD II.

	First.	Second.
1.	65,386.	4,951.
2.	6,554.	6,588,400.
3.	1,412,474.	9,088 + 2.
4.	72; 63; 144.	2s. 3d.; 3s. 10d.; 6s. 7d.

Third.

1. 59,066.
2. 40,598,040.
3. 9,897.
4. 8s. 9d.; 10s. 8d.; 11s. 9d.

STANDARD III.

	First.	Second.	Third.
1.	4,608.	10 apples.	£15,506 1s. $5\frac{3}{4}$d.
2.	5,860.	£10,926 0s. $6\frac{3}{4}$d.	1,234 acres.
3.	8,600 + 100.	£96,490 5s. $10\frac{1}{2}$d.	£123 6s. $11\frac{3}{4}$d.
4.	115 sheep.	£34 4s.	7s. 8d.

STANDARD IV.—FIRST.

1. £3,984 9s. $4\frac{1}{2}$d.
2. £596 18s. $11\frac{1}{2}$d.
3. £4,751 6s. $8\frac{3}{4}$d. + 10.
4. £487 18s. $2\frac{1}{4}$d. + 6.

SECOND.

1. £17 14s. 2d.
2. 14,320 oz.
3. 5,918 qrs. 4 bus. 1 pk. 1 gal. 2 qts.
4. £8 11s.

THIRD.

1. 4,400 rulers.
2. 7,862,400 sec.
3. 429 reams 4 quires.
4. 10 yards.

STANDARD V.—FIRST.

1. £833 9s. 11d.
2. £446 14s. 11d.
3. £941 6s. 6d.
4. £202 14s. 9d.

SECOND.

1. £864.
2. 11s. 6d. + 7s. $3\frac{1}{2}$d. + 7s. 11d. + 8s. $1\frac{1}{2}$d. + 9s. $0\frac{3}{4}$d. = £2 3s. $10\frac{3}{4}$d.
3. £351,575 1s. $9\frac{1}{4}$d.
4. 24 days.

THIRD.

1. $\frac{11}{12}$.
2. £49 17s. 6d.
3. $\frac{1}{3} + \frac{3}{13} + \frac{4}{39} = \frac{8}{9}$.
4. House £602 13s. 4d., garden £75 6s. 8d.

STANDARD VI.

	First.	Second.
1.	Greatest $\frac{8}{11}$, least $\frac{9}{10}$.	£44 17s. 9d.
2.	$\frac{3}{5}$.	·09375.
3.	12,800.	1s. $10\frac{1}{2}$d.
4.	4·44.	1,080 inches.

THIRD.

1. £901 14s. $10\frac{1}{2}$d.
2. $6\frac{1}{2}$ per cent.
3. £350.
4. £785.

STANDARD VII.

	First.	Second.
1.	156,000 bricks.	£4 9s. 3d.—£4 7s. 6d. = 1s. 9d.
2.	·104051.	6·80536.
3.	£34 13s.	£399 1s. 10d.
4.	$2\frac{1}{2}$ years.	$1\frac{1}{11}$ errors.

THIRD.

1. 5 per cent.
2. £195 2s.
3. £8,021 8s. $1\frac{1}{2}$d.
4. 2s. 11d.

WINTER.

Andante expres.
mf.

1st TREBLE.
2nd TREBLE.
BASS.
1. Sweet sum - mer days are de - clin - ing, With all their gold - en hours;..... And
2. But spring new beau - ties re - veal - ing, Will soon re - turn a - gain; ..... And
KEY A. mf. Andante expres.
dim - ly the sun is shin - ing, Through fad - ing groves and bow - 'rs.
bright - ly the sun will be shin - ing, On moun - tain, grove and plain. .....
E.t.
The woods that late - ly were ring - ing, Are si - lent now and lone; ..... The
Come win - ter then we will greet thee, Thy robes are pure and white; ..... Each
f.A. f
cres.
warb - lers have ceas'd their sing - ing, The sum - mer birds are flown. .....
blos - som shall slum - ber sweet - ly, The long, long win - ter night. .....

Notes of Lessons on Climate.

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PART II.

INFORMATION ARRANGED IN ORDER OF TEACHING.

A. Introduction.

Revision of last lesson.

1. The climate is hottest in tropical regions in consequence of the vertical or almost vertical course taken by the sun.

2. The cold climate of the Polar regions is mainly due to the low altitude attained by the sun in the heavens.

3. The difference between the heat of summer and winter is greatest in high latitudes and increases the further we proceed from the equator.

B. The climate of a district is affected by its elevation above the sea-level.

1. The air is not warmed to any great extent by the sun's rays passing through it, but it is heated chiefly by contact with the warm surface of the land.

2. Hence as we rise, say in a balloon, the temperature of the air becomes lower the higher we ascend.

3. For the same reason plateaux and mountain summits are much colder than the valleys and low-lying plains in corresponding latitudes.

4. The **snow line** in various latitudes indicates the different heights to which we must climb in order to reach a constant temperature of either 32° Fahr. or below.

The following snow line heights should be known—

	Snow Line.
(*a*) **Europe**:—	
North Norway	1,000 ft.
South Norway	4,500 ft.
Ben Nevis is below the snow line...	150 ft.
The Alps	9,000 ft.
(*b*) **Asia**:—	
Himalayas (S. slope)	15,000 ft.
„ (N. slope)	18,000 ft.
(*c*) **Africa**:—	
Kilimanjari	16,400 ft.
(*d*) **America**:—	
Andes above Quito	16,000 ft.

ILLUSTRATIONS AND TEACHING HINTS.

The chief results of last month's lesson should be obtained from the class by means of a series of questions like the following:—

(*a*) Mention two places which have very great differences of climate.

(*b*) What is the chief reason for the climate at the equator being much hotter than that near the Poles.

(*c*) On March 21st what height is the sun above the horizon at mid-day (*a*) at the equator (*b*) at London and (*c*) at the North Pole.

(*d*) In what latitude is the difference between the summer and winter temperature greatest.

(*e*) Where is the day and night always of equal length.

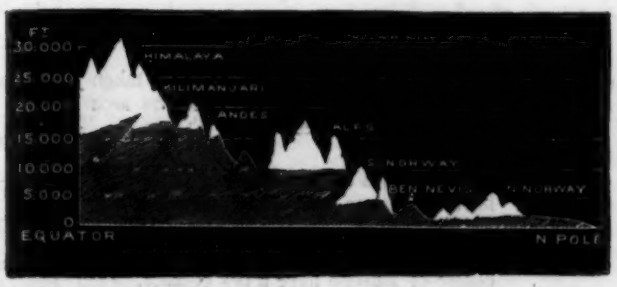
(*f*) Draw two diagrams to show why the length of the day in London varies more than it does on the Tropic of Cancer.

1. Illustrate this statement by reference to the cool surface of the sea in summer as compared with the heated pavement of the street in town, and appeal to the experience of the class as to the difference in the temperature of the air over each surface respectively.

2. Emphasize this statement by the fact that the temperature is estimated to lower 1° Fahr. for every 300 ft. ascent.

3. Relate the custom of the Viceroy and Government of India, who remove from Calcutta in the hot season and reside on the elevated slopes of the Himalaya Mountains. These Sanataria, or 'hill stations' are common in India.

4. In the following diagram the snow line is shown to rise higher as we select mountains nearer the equator.



C. Effect of Proximity to the Sea and of Ocean Currents upon climate.

1. In the same latitude the sea is cooler in summer and warmer in winter than the land near to it.

2. Hence the temperature of places near the sea is higher in winter and lower in summer than that in corresponding latitudes a considerable distance inland.

The term Insular is applied to climates modified by the sea whilst Continental is applied to climates which exist in the midst of large land areas.

3. **Ocean currents** intensify the influence of seas in modifying the climate of countries near them.

(*a*) If the current is flowing from tropical regions to colder latitudes it heightens the temperature of the breezes which blow over it and the neighbouring shores.

(*b*) On the contrary, if the current is flowing from polar regions toward the equator, all places it reaches will be made much colder by its approach.

1. Refer to the pupils' sea-side experience of the delightfully cool breezes from the sea as compared with those from over the land. The second fact must be told, as children rarely visit the sea-side in winter and the difference in temperature is not so marked at that season.

2. The following diagrams represent graphically the facts which prove the truth of our reasoning.

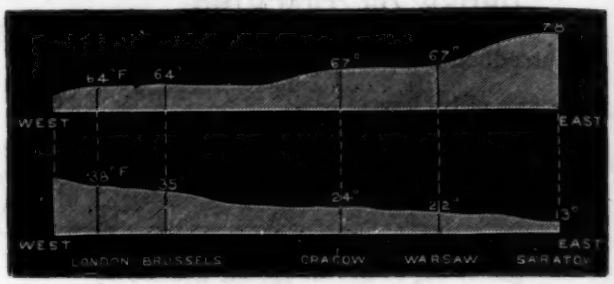


Fig. 2. Showing difference of temperature between western and central Europe.

3. This is best taught by showing on a map of the world the position of the Gulf Stream, and connecting with it the remarkably high winter temperature of ports on the west coast of Europe, *e.g.*

(*a*) Galway has a winter temperature of 41° Fahr. whilst Berlin has a temperature of only 27° Fahr.

(*b*) The port of Hammerfest in the north of Norway is open all the year, whilst all the Baltic ports are closed during several months of winter.

(*c*) Contrast the winter temperature of the west coast of Ireland washed by the warm current from the equator with the temperature of the coast of Labrador chilled by the near passage of a current from the Arctic Seas, Ireland = 40° Fahr., Labrador = 14° Fahr.

D. The slope of the land affects climate.

1. The slope of most districts can be determined by reference to the direction of the chief rivers of that district. Thus the Tyne, Wear, and Tees drain the eastern slope of the Pennine Range, whilst the Lune, Ribble, and Mersey drain the western slope.

2. When a district in Western Europe slopes toward the south or south-west that district is generally warmer than one in the same latitude facing either north or north-east.

1. Show the position of these slopes on a map of England and allow the class to indicate other slopes.

Fig. 3.

2. Quote the example of Lancaster and Carlisle on the west slope having a winter temperature of 38° Fahr., whilst York has a winter temperature of 33° Fahr.

E. Climate and Rainfall.

1. **The amount of rain in any area is taken into account when the climate of the area is described. Thus we say:—**

(*a*) **Ireland and the west coast of Gt. Britain have a moist or humid climate.**

(*b*) **The east coast of England and the centre of Europe have a dry climate.**

1. Refer to the weather on any particular rainy day and compare it with the weather on any sunny day, and thus show the cooling effect of clouds and rain upon the climate.

(*a* and *b*) Compare by means of Fig. 4 the west of Ireland and the west of England with the east coast of England as to the amount of rain.

It will be seen that whilst in the west the rainfall at the sea level is not less than 50 inches per year, on the east it does not reach more than 25 inches. Thus illustrate the meaning of *humid* and *dry* climate.

2. The amount of rainfall for any area may generally be determined in one of the following ways:—

(*a*) There is more rain in countries near the sea than in the centre of continents.

(*b*) Mountain regions are rainy whilst the neighbouring lowlands and plains are generally dry.

(*c*) More rain falls in the tropics than in any other region.

2. (*a*) This will be evident if it is pointed out that the air in passing over the ocean absorbs moisture, and deposits much of its moisture on the neighbouring coasts.

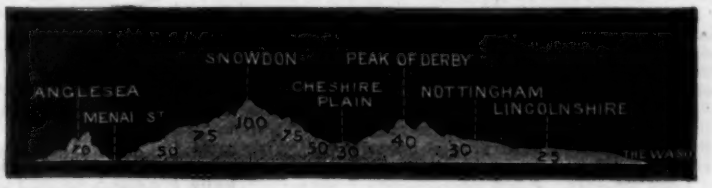


Fig. 4. Rainfall determined by elevation of land and proximity of the sea.

(*c*) State that whilst the average rainfall in England is about 30 inches, in Sierra Leone it is nearly 200 inches, near Bombay it is over 300 inches, and on the hills to the north-east of Calcutta the rainfall is over 500 inches annually.

F. Weather and Climate.

1. **Weather** refers chiefly to the temperature, to the state of the sky—bright, or cloudy, or rainy—and to the direction and force of the wind at a particular locality for a particular day.

2. **Climate** is determined by taking an average of the temperatures, of the rainfall and rainy days, and of the prevailing winds over a considerable area and spread over several years.

The children may be led to enumerate the chief features which make up our weather. Contrast with their notion of weather that which this lesson teaches them about climate. When this difference can be clearly stated, the statement may serve in the place of a strictly logical definition.

BLACKBOARD SKETCH.

1. **Effect of Elevation.**
   - (*a*) The air is warmed by contact with the land.
   - (*b*) The higher we ascend the cooler the air becomes.
   - (*c*) The snow line varies in height with the latitude.
2. **Proximity of Sea.**
   - (*a*) The sea is cool in summer and warm in winter.
   - (*b*) Districts near the sea have an **Insular climate.**
   - (*c*) Countries far inland have a **Continental climate.**
   - (*d*) **Ocean Currents:—**
     1. From Equatorial regions carry **warmth.**
     2. From Arctic regions chill the air.
3. **Rainfall** is greatest near the sea, and upon Mountain slopes.
4. **Weather** takes notice of temperature, etc., for a particular day. **Climate** takes account of temperature, etc., for many years.

Helps to the Study of Shakespeare's 'Hamlet.'

ACT III. Scene 2—*continued.*

Lines 226—231. *Thoughts black . . . . usurp immediately.* Notice the succession of six nouns used absolutely in the first two lines of this speech. *Confederate season,* the time conspiring with the murderer's will, and affording opportunity. *Hecate's ban,* the evil influence of Hecate—of witchcraft. *wholesome,* healthy. *magic* and *property* are nominative to *usurp on.* The latter phrase implies seize and exercise cruel control over.

Lines 232—234. Hamlet continues to play the part of interpreter.

Lines 242—243. *Why let . . . ungalled play.* Compare 'Let the galled jade wince, our withers are unwrung,' earlier in this scene.

Lines 246—256. *Would not this . . . . rhymed.* In this passage Hamlet claims some credit for his share in the play. *forest of feathers,*—allusion is made to the practice of wearing feathers on the stage. *turn Turk with me,*—popular expression for apostasy of any sort, become cruel to me. *Provincial roses,*—rosettes of ribbon shaped like roses and worn on the shoes. 'Provincial' may mean *Provençal,* from *Provence,*—or of Provins, a place in Lower Brie; in either case it applied to a large red rose. *razed shoes* means slashed, or ornamentally laced open shoes. Some critics think it should be *raised,* that is high shoes, having high heels. *a fellowship,*—a share. *a cry of players,*—a troop or company of players. *A whole one, I,* may mean 'a whole one, I say;' or, according to Malone, *ay* may be intended to carry on the sense to the quoted stanza. *pajock* is believed to stand for peacock, which Pope and some later editors substituted. It has also been suggested that the word is a corruption of *patchock* for clown. The rhyme which Horatio hints at is obviously *ass,* and the drift of the conversation seems to be a depreciation of the dramatic taste of contemporary audiences.

Line 262. *the recorders,*—These were musical instruments like a flute or flageolet. It seems probable that they had a mouthpiece like the latter, and Staunton quotes a passage from Chappell's '*Popular Music of the Olden Time,*' to show that recorders, like violins and other instruments, were made of different sizes so as to play different parts of harmonised music.

Lines 264—306. *perdy,* corrupted form of the French oath *par Dieu. marvellous distempered,*—marvellously disturbed or disordered. Hamlet pretends to understand this as a physical

disorder as from drunkenness. *choler*,—anger, from Greek χολος, bile. Note use of 'should' for 'would;' 'more richer,' double comparative; 'purgation,' used with double meaning, medical and legal; 'frame' is used for orderly form. Hamlet's answers to Guildenstern have an appearance of trifling, as when he says 'I am tame,' 'You are welcome.' It seems to be Hamlet's intention to feign a sort of madness. 'wholesome answer' means a rational or sensible answer. 'amazement' means bewilderment, mental trouble, 'admiration' wonder. 'shall obey' is used for 'will obey.' 'trade' means business. 'pickers and stealers'—hands; compare the phrase 'from picking and stealing' in the church catechism.' To swear by the hands was a common form of asseveration. 'Your cause of distemper'—the cause of your distemper, disordered reason.

Lines 307—311. *I lack advancement*,—I am not sufficiently promoted. *You have the voice of the King*,—it will be remembered that the king has recognised Hamlet as next in the succession to the throne. *While the grass grows*—the steed starves. Hamlet may have in his mind that he really ought to be king without waiting for the usurper's death.

Line 312. *To withdraw with you.* This may be simply an absolute use of the infinitive to recall attention to the business with Guildenstern—or to suggest speaking privately. Staunton suggests the reading 'So—[*taking a recorder*] withdraw with you;' and considers that these words indicate the departure of the players in whose presence the succeeding conversation could hardly have taken place.

Line 313. *to recover the wind of me*,—an expression used in hunting with reference to the practice of keeping to the windward of the animal pursued, so that, running with the wind, it may not scent its pursuers, and may be driven into the toil or snare without warning.

Lines 317—338. *Will you play upon this pipe?...play upon me.* In this conversation Staunton thinks that Rosencrantz should bear some part and that Hamlet's 'I do beseech you' marks the turning from one to the other of his old schoolfellows. *vantages*,—holes in the recorder for the wind to pass through, from Latin *ventus*, wind. *fret me*,—chafe or irritate me; there is also a reference to the frets or stops consisting of pieces of wire placed on the lute and guitar as guides for the fingers in stopping the strings for the different notes; from French *frotter*, to rub.

Lines 341—365. *presently*, at once; *by-and-by*, immediately. These two expressions both originally meaning at once, have come to mean a little while hence. *They fool me to the top of my bent.* They make a fool of me, or regard me as a fool, as far as my inclination goes. *The soul of Nero.* Nero, the cruel Emperor of Rome, murdered his mother Agrippina. *speak daggers.* Compare, in Scene 4 of this Act, 'These words like daggers enter in mine ears.' *shent*, participle of an old English verb *shend*, Anglo-Saxon *scendan*, to reproach, to scold. It also means to punish, and to destroy. *to give them seals*,—to carry words into acts, that is, to use real daggers.

Act III. Scene 3.

Lines 1—26. *Stands it*,—is it. *range*,—have free scope. Notice *prepare you*, and *arm you*, where we should use *yourselves*. *shall along*,—for shall go along. *many many*,—intensive force of repetition as *too too* in Act I. Scene 2. *peculiar life*,—private person. *noyance*,—injury, a rather stronger word than annoyance, derived from Latin *nocere*, to injure, through the French. *weal*,—welfare. *cease of majesty*,—death of the king; 'cease' is not elsewhere used as a noun. *like a gulf*,—like a whirlpool; compare the word *engulfs*. *massy*,—massive, Shakespeare does not use the latter form. *lesser*,—double comparative. *mortised*,—fitted, as a tenon and mortise joint. *annexment*,—only use of this word. *general groan*,—grief of the people accompanies a king's sorrow. *this fear*,—this cause of fear. Note several instances of inversion in this passage, as 'I your commission will forthwith dispatch'; 'We will fetters put.'

Lines 27—35. *process*,—proceedings. *warrant*,—cognate form of *guarantee*; *tax him home*,—censure him thoroughly: compare the expressions 'strike home,' 'to drive anything home.' Notice the change of number from *mother* to *them*. *of vantage*,—at an advantage, or from a favourable position.

Lines 37—72. *primal*,—from *prime*, Latin *primus*, first, like original from origin. *eldest*,—oldest, the form *eld* was formerly used. *curse*,—the reference is to the curse of Cain. *Though inclination be as sharp as will*,—though inclination is so strong as to amount to resolution. *to double business bound*,—having two pieces of work to do. *Is there not rain enough . . . .* compare Macbeth's 'Will all great Neptune's ocean wash this blood clean from my hand?' and Lady Macbeth's 'All the perfumes of Arabia will not sweeten this little hand.' *to wash it white as snow.* Compare in the Psalms, 'Wash me, and I shall be whiter than snow.' *to confront the visage of offence*,—to stand face to face with wrong-doing. *prayer*,—a dissyllable like 'hour' and other similar words. *forestalled*,—prevented. *ambition*,—object of ambition; *offence*,—fruits of the offence. Notice confusion of metaphor in 'corrupted currents' and 'offence's gilded hand,' *his* used for its, and ellipsis in 'we ourselves compelled.' *rests*,—remains. *Try*,—infinitive without 'to,' used absolutely. *can*,—used as principal verb. *limed*,—dissyllable, caught as a bird with birdlime. *engaged*,—entangled, trammelled. *Make assay*,—make trial, effort.

Lines 73—98. *pat*,—in the nick of time, aptly. *would be scann'd*,—needs to be examined carefully, *Salary*, from Latin *salarium*, money paid to Roman soldiers for salt, *sal*, salt. *grossly*,—in a sinful state, with his evil deeds unrepented of, compare the ghost's words 'Cut off even in the blossoms of my sin, Unhousel'd, disappointed, unaneled.' *full of bread*,—not fasting, compare the phrase 'fulness of bread' describing the state of Sodom and Gomorrah in Ezekiel xvi. 49. *flush*,—abounding. *his audit*,—his reckoning. *in our circumstance and course of thought*,—according to our knowledge and judgment. *purging of his soul*,—cleansing it from sin by prayer and repentance. *season'd for his passage*,—prepared for his death. The words pass, passing and passage, are often used to express the idea of dying, compare *passing bell*, 'Passing of Arthur,' Tennyson. *hent*,—literally grasp or grip, derived from *hentan* to seize, whence the words *hand*, *hunt*. *relish*,—taste or flavour, from the verb *lick*. *This physic*,—this act of praying; this meaning seems more probable than this forbearance or delay on my part, as suggested by some editors.

Scene 4.

Notice use of *straight* as adverb, also *home*; *broad*, for evident, open to public view; *heat*, the king's anger. *sconce*, an emendation for *silence*, which would however be permissible, but *ensconce* is similarly used in Merry Wives of Windsor. *round*, plain. Mark the quick pointed responses Hamlet makes to his mother's rebukes, lines 9—12. *by the rood*, by the cross or crucifix, an old form of oath; compare, *rood-loft*, the place where the crucifix was placed in a church or abbey, also *Holyrood*. *budge*,—to move or stir, French *bouger*. *for thy better*,—for the king. *too busy*,—meddlesome, officious, like a busy-body. *brass'd it*,—encased it with brass, hardened it. *proof and bulwark against sense*,—armour-clad and defended against natural feeling. *such an act that*,—where we should use 'as' for 'that.' *a blister there*,—probably the result of branding for unchastity is referred to. *dicers' oaths*,—gamblers' vows. *contraction*,—peculiar use of the word for the act of making a contract of marriage. *rhapsody*,—a wild medley, fine high-sounding words with no real meaning. Greek ῥαψωδια, from ῥαψω, to sew, ωδη, a song. *glow*,—blush with shame. *this solidity and compound mass*,—the earth. *tristful visage*,—sorrowful countenance, from Latin *tristis*, sad. *as against the doom*,—as if the judgment-day were near. *thought-sick*,—sick with anxiety. *the index*,—table of contents, here representing the preamble to a speech. *counterfeit presentment*,—representation in portraits. *Hyperion*,—Apollo, God of the sun, accented by Shakespeare on second syllable, properly on third. *Jove*,—father of the Gods, Jupiter. *Mars*,—god of war. *station*,—attitude. *the herald Mercury*,—Mercury the messenger of the Gods. *New-lighted*,—newly alighted. *wholesome*,—healthy. *batten*,—feed to excess, grow fat, from Anglo-Saxon *batan*, to bait, or root of *better*. *heyday*,—wild spirit of youth. *apoplex'd*,—made inactive by apoplexy, compare *paralysed*, only occurrence of the word apoplex as a verb. *ecstasy*,—madness. *thrall'd*,—enslaved. *to serve in such a difference*,—to be of service where the difference was so great. *cozen'd you at hoodman blind*,—cheated you at the game of blind man's buff. *cozen*, is said to be a corruption from cousin, and meant to treat as a relative for the sake of personal advantage. *sans all*,—without everything, compare Shakespeare's well-known description of second childhood in *As You Like It*. *mope*,—be dull, senseless. *mutine*,—mutiny, rebel. *grained*,—dyed in grain, originally a scarlet dye, afterwards any fast colour. *leave their tinct*,—give up their colour. *tithe*,—a tenth part. *precedent*,—accent on second syllable: when used as a noun, on the first. *a vice of kings*,—a buffoon or clownish king, like the vices in the old moralities. *cutpurse*,—a robber; purses were worn outside the dress attached to the girdle. *from a shelf*,—like a petty thief, the words convey the idea of contempt. *Diadem*, a band or fillet worn round the head a symbol of royalty, Greek διαδημα. *of shreds and patches*,—of motley dress like a clown. *lapsed in*

time and passion,—dilatory in allowing time to pass and anger to cool down. *blunted purpose*,—the ghost adopts Hamlet's self-accusation as deserved. *conceit*,—imagination. *incorporal*, for incorporeal, unsubstantial. *bedded hair*,—hair matted as after sleeping in bed. *excrements*,—hair and nails. *start* and *stand*, used as if hair were plural, the verbs may be attracted into the plural by the intervention of the plural noun excrements. *capable*,—able to feel. *my stern effects*,—the carrying into effect of my stern purposes. *in his habit as he lived*,—in his ordinary dress. *coinage of the brain*,—the product of fancy. *re-word*,—repeat word for word. *Forgive me this my virtue*: Hamlet seems to be apostrophising his own virtue not the queen. *pursy*,—swelling with pride, puffed up. *curb*,—bend and truckle. *worser*,—double comparative like lesser.

That monster, custom, ... put on:—Common use is like a monster which devours all natural feeling, but though it is the evil genius of our actions, it manifests itself as a good spirit in giving to good deeds by dint of practice the character of an easy-fitting garment; that is repeated efforts make it easy to do right. *bloat*,—bloated. *that I essentially am not in madness, but mad in craft*,—I am not really mad, I only pretend to be. To say this is one of the things the queen is not to do. The whole passage is bitterly ironical; but these words help to prove that Hamlet's madness was only feigned. *paddock*,—a toad; *gib*,—tom-cat. *like the famous ape*. An old fable seems to be referred to in which an ape, after unfastening a basket and letting some birds fly out of it, got into it himself, and then tried to fly also, but broke his neck. The editors have not discovered the fable. *I must to England*. How Hamlet learned this the play does not show. *There's*, often used for there are. *enginer*,—for engineer, like *mutiner* for mutineer in this play. *hoist with his own petard*,—blown up with a shell of his own making: *hoist* is used as a participle, to hoist being a verb which has its participle contracted. *packing*,—plotting, arranging. *neighbour*,—neighbouring.

In the space remaining at our disposal we cannot continue to the end of the play the detailed verbal annotations which indeed have already extended beyond what was intended. But if the course suggested in an early portion of these papers has been followed, the student will have made much progress on the lines laid down, and will find little need for similar notes on every point which presents itself. The vocabulary, the style, the construction, metrical and grammatical, all grow more familiar as we proceed, and we find comments on early passages suggest explanations of others which occur later. Our remarks on the language of Acts IV. and V. will accordingly be very brief.

ACT IV. Scene 1.

Brainish apprehension,—compare 'Coinage of the brain,' in preceding scene. *short*,—under control. *divulging*,—active participle used for passive. *untimely done*,—done with violence. *to his blank*,—to its mark, the white part of the target.

Scene 2.

Replication,—reply, answer. *like an ape*,—'as an ape doth nuts,' the reading of the quarto edition of 1603, is adopted by Staunton, and appears the more reasonable. *A thing of nothing*,—a thing of no importance. *Hide fox, and all after*,—probably a game like Hide and Seek.

Scene 3.

Your worm,—an indefinite or impersonal use of the pronoun. *variable*,—various. *tender*,—care for. *dearly grieve*,—heartily, compare use of 'dearest' in 'dearest foe.' *cicatrice*,—scar of a wound, from Latin *cicatrix*. *coldly set*,—treat with indifference. Compare 'set at nought.' *congruing*,—'conjuring' has been suggested with sense of adjuring. *hectic*,—fever, from Greek ἕξις, habit, the word being applied to a habitual fever. *haps* may be as Johnson suggested for 'hopes.'

Scene 4.

Rendezvous,—place of meeting, French *rendez-vous*, render yourselves or betake yourselves. *express our duty in his eye*,—give expression to our respect in his presence. *the main of Poland*,—Poland as a whole. *addition*,—exaggeration. *yield a ranker rate*,—afford a fatter, greater profit. *sold in fee*,—sold as freehold. *debate* for decide. *imposthume*,—an internal abscess, probably corrupted from Greek ἀπόστημα, an abscess, Latin *apostema*, old French *apostume*. *market of his time*,—employment of his time for profit. *fust*,—grow musty, compare adjective 'fusty' from French *fusté*. *craven scruple of thinking too precisely on the event*,—cowardly hesitation from dwelling too minutely on the possible issue of the matter. *makes mouths at the invisible event*,—mocks at the future. *fantasy and trick of fame*,—imagination of possible fame, and artifice inspired by thought of fame. *continent*,—that which contains.

Scene 5.

Distract,—contracted form for distracted, distraught. *unshaped*,—incoherent. *collection*,—the attempt to gather meaning by piecing her utterances. *aim*,—guess. *ill-breeding*.—breeding mischief, in this compound 'ill' has a substantive, not an adverbial force. *Each toy seems prologue to some great amiss*,—Every trifling incident suggests the dread of some catastrophe. *So full of artless jealousy, etc.* Compare 'Suspicion haunts the guilty mind.' *cockle-hat*,—the hat adorned with a cockle-shell was the mark of a pilgrim. *shoon*,—old plural for shoes, compare *een*, Scotch for eyes, *housen*, still used in Midland counties for houses. *larded*,—adorned, decked. *God'ild you*,—for 'God yield you.' God grant you favour or reward. *They say the owl was a baker's daughter*.—A story is told in Gloucestershire of our Saviour, applying for bread at a baker's shop, being rudely received by the baker's daughter; and for her unkindness she was turned into an owl. *Single spies*,—scouts sent to reconnoitre before an army. Compare 'Troubles never come alone.' *remove*,—removal. *muddied*,—disturbed, bad blood having been stirred up. *greenly*,—unwisely. Compare 'you speak like a green girl.' *in hugger-mugger*,—hurriedly and privately. *buzzers*,—whispering mischief-makers. *Wherein necessity in ear and ear*,—In which speeches for lack of information the whisperers will not hesitate to introduce charges against ourselves and so spread them broadcast. *murdering-piece*,—a cannon loaded not with a ball but case-shot, a rude forerunner of the *mitrailleuse*. *Switzers*,—body-guards, from the custom of employing Swiss mercenaries as royal guards. *overpeering of his list*,—looking over, overflowing its boundary. *a riotous head*,—a rebellious band. *on the false trail they cry*,—an expression drawn from the chase. *this is counter*,—this is following the scent in the wrong direction. *Let him go Gertrude*,—The queen clinging to Laertes tries to keep him from attacking the king. *That both the worlds I give to negligence*,—I care neither for this world nor the next. *throughly*—thoroughly. *swoopstake*,—sweepstake, a form of gambling in which the winner sweeps off all the stakes. *life-rendering pelican*,—in reference to the fable of the pelican feeding her young with blood from her own breast. *as level to your judgment*,—as direct to your understanding. Compare 'as level as the cannon to his blank.' Act IV., Sc. 1. *fine in love*,—delicate and tender. *precious instance*,—rich example, here referring to Ophelia's mental endowments, which appear to have been of a high character. Her reason followed her father's life. *the wheel*,—probably the reference is to the spinning-wheel, which is associated with many old songs, but Staunton says 'wheel' was a name applied to the burden or refrain of a song. *rosemary*,—this herb was supposed to strengthen the memory. *pansies*,—from French *pensées*, thoughts. *document*,—instruction, from Latin *doceo*, I teach. *fennel*,—this herb symbolises flattery; it is given to the king, with columbines, a flower which it has been suggested may be the emblem of thanklessness. *rue*,—for ruth, repentance is given to the queen. *herb of grace*,—was a religious name having the same meaning. *with a difference*,—for a different reason. *daisy*,—emblem possibly of dissembling, and so given to the king or queen. *violets*,—emblem of faithfulness, perhaps mentioned to Horatio. *touched*,—implicated. *hatchment*,—corruption of *achievement*, the name in heraldry for the escutcheon of a person who is dead.

Scene 6.

Means to the king,—opportunity of access to the king. *thieves of mercy*,—thieves having mercy. *the bore of the matter*,—a metaphor taken from a gun-barrel, the larger the bore the heavier the charge required.

Scene 7.

Much unsinew'd,—lacking nerve, very feeble. *be it either which*,—'whichever of the two it may be,' or possibly 'let it be either which you will.' *conjunctive*,—closely joined. *public count*,—public trial. *general gender*,—the common people, 'gender' being used for race of men. *spring that turneth wood to stone*,—petrifying spring, like the dropping well at Knaresborough. *gyves*,—fetters, formerly for the ankles, since used more generally. Compare Hood's 'Eugene Aram,' 'with gyves upon his wrist.' *loud a wind*,—a strong wind would drive back arrows of a light make,—so the general applause of Hamlet would hinder his punishment. *stood challenger on mount of all*

the age. Mr. Moberley thinks there is here an allusion to a custom at the coronation of the King of Hungary, when he stands on the Mount of Defiance at Presburg, unsheathes his sword, and challenges all the world to dispute his rights. *abuse,*— forgery. *character,*— handwriting. *checking at,*— a metaphor from hawking, the term expressing the hawk's abandonment of the proper game for some other bird. *uncharge the practice,*—bring no accusation against the contrivance. *organ,*—instrument, means. *unworthiest siege,*—least worthy rank, 'siege' used for seat, position. *a very riband,*—no more than an ornament. *weeds importing.*—clothes which betoken. Compare 'widow's weeds.' *can,*—used as principal verb, for can do. *incorpsed and demi-natured,*—incorporated with, made one with, like the fabled centaur. *forgery,*—imagination. *brooch,*—conspicuous ornament worn in the hat. *scrimers,*—fencers, from French *escrimeurs. plurisy,*—plethora, used as if derived from *plus, pluris,* more. *this 'would,'*—this expression of willingness. *this 'should,'*—this admission of duty. The sense of the passage is that the accomplishment of one's will is apt to be hindered by many circumstances, and the recognition of a duty one has not will to do is apt to grow weaker. *no place should murder sanctuarize,*—no place should shield a murderer from his just punishment. *remiss,*—careless. *peruse the foils,*—examine carefully the blunted weapons. *unbated,* not made harmless by a button on the point. *a pass of practice,*—'a treacherous thrust.' *unction,*—ointment. *mountebank,*—a quack-doctor, from Italian *montimbanco,* one who mounts a bench. *cataplasm,*—a poultice, or moist plaister. *simples that have virtue under the moon,*—herbs that will heal when gathered in the moonlight. Compare 'culling of simples' in 'Romeo and Juliet.' *may fit us to our shape,*—may be convenient for carrying out our proposal. *drift,*—intention. *blast in proof,*—like a gun or cannon burst to pieces in being tested. *chalice for the nonce,*—cup for the occasion, for the nonce corrupted from *for than anes,* n transferred from previous word. *chalice* from *calyx,* cup of a flower. *venomed stuck,*—poisoned stab. *hoar,*—white, gleaming. *crow-flowers,*— either marsh-gilliflowers, cuckoo flowers, or ragged robin. *long purples,*—probably the *orchis mascula. liberal,*—coarse in speech. *sliver,*—a branch broken from the tree, from verb *slive,* to strip off. *incapable,*—insensible. *indued,*—naturally fitted or endowed. *trick,*—habit. *The woman will be out,*—what is womanish will have passed away. Compare Wolsey, 'thou forcest me .... to play the woman.' *douts,*—puts out, contracted from do out.

ACT V. Scene 1.

Straight,—immediately. *crowner,*—coroner. *argal,*—for *ergo,* therefore. *delver.*—digger, from *delve. nill he,*—negative of will he from *ne will he.* Compare the negative words formed by initial *n,*—none, neither, never. *quest,*—inquest. *even Christian,*—fellow Christian. *unyoke,*—cease your work. *Mass,*—for 'by the Mass.' *Yaughan,*—may be corruption of John or Johan, and refer to some inn-keeper. Collier suggests it may be corrupted from a stage direction 'to yawn.' *stoup,*—a drinking cup, the word is still used in Scotland, and in college-halls in England. *for a,*—the *a* at the end of this and other word probably represents a drawl or a slur. *intil,*—for into. *jowls,*—knocks. *politician,*—schemer, always used by Shakespeare in a bad sense. *chapless,*—jawless. *mazzard,*—skull. *loggats,*—an old game somewhat resembling bowls, but played on a floor strewn with ashes. A similar game is said to be played in New England under the name of 'loggerheads,' 'loggat' is diminutive form of log. *For and,*—and also. *quiddities,*—subtleties, quibbles, from *quidditas,* Latin for the essence of a thing. *quillets,*—corruption of *quidlibets,* whence *quibble.* Lord Campbell remarks on the exact use of all the law terms in this speech. *sconce,*—playful and familiar word for head, like 'mazzard' above. *statutes,*—not only appled to Acts of Parliament, but to bonds or deeds made in accordance with Acts. *recognizances,*—bonds acknowledging loans. *fine of his fines,*—the end of his fines, notice the continued word-play. *pair of indentures,*—contracts made out in duplicate, each party keeping one. As both were written on one sheet of parchment and then cut through on a zigzag line the indentures would fit together, and so afford proof of genuineness; derivation, Latin *dens, dentis,* a tooth. *inheritor,*—possessor. *jot,* from *yod,* smallest letter of Hebrew alphabet, through Greek ιωτα. *parchment,*—from Latin *pergamena,* from *Pergamus* in Asia Minor, where it was first made. *quick,*—living, still used in some parts of England. Compare 'the quick and the dead' in the Creed, 'quicklime,' 'quicksilver.' *by the card,*—by the chart used for navigation, also, by the mariner's compass, 'to sail by the card' means to sail carefully with exact reference to directions indicated, Staunton prefers to consider that 'card' means calendar of etiquette or book of manners. *to picked,*—so particular, precise. *kibe,*—chilblain on the heel. *Yorick,*—may be corrupted from *Rorick,* name of an ancestor of Hamlet, or from *Yorg,* Danish form of George. *gibes,*—jeers, scoffing jokes. Compare Lord Beaconsfield's phrase—'a master of gibes, and flouts, and sneers.' *favour,*—appearance, especially of the features of the face; compare ill-favoured, well-favoured. *too curiously,*—too minutely, with too much care. *modesty,*—moderation. *flaw,*—gust of wind, compare in Longfellow's Wreck of the Hesperus—'the veering flaw.' *maimed rites,*—ceremonies less complete than usual, it was the English custom to bury a suicide without the burial service at the meeting of four roads. *fordo,*—undo, destroy, compare force of for in *forget, forgo. couch we,*—let us couch or stoop down to hide. *shards,*—potsherds, pieces of broken earthenware rubbish, the word is from *shared,* divided. *virgin crants,*—garlands such as were carried before a maiden's coffin, from German *kranz,* a garland, Scotch *crance. Strewments,*—strewing of flowers. *peace-parted souls,*—those who have departed in peace. *Pelion,*—a mountain in Thessaly. *Olympus,*—a mountain between Thessaly and Macedonia, the fabled abode of the Gods. *splenitive,*—hot-tempered, hasty, from the *spleen,* which organ was considered the seat of anger. Compare 'vent my spleen' in Julius Cæsar. *wo't,*—wouldst thou, a familiarity implying contempt. *eisel,*—probably vinegar from Anglo Saxon *aisil*; it has been suggested that 'eisel' stood for the name of some supposed lake Esyl in Scandinavia, or the river Yssel, but there seems no warrant for this far-fetched explanation. *Ossa,*—another mountain of Thessaly. *golden conplets are disclosed,*—two young doves just hatched, and covered with yellow down. *the present push,*—trial without delay.

Scene 2.

Mutines in the bilboes,—mutineers in fetters such as were used for punishing sailors; 'bilboes,' from Bilboa, a town in Spain, famous in very early times for manufacturing iron. *rough-hew,*—make a rough plan, or sketch out. It appears that 'rough-hew' was also used as a technical term in making wooden skewers, and meant shaping them roughly preparatory to their ends being pointed. *larded,*—interspersed to gloss over the intention. *bugs and goblins in my life,*—bogeys, bugbears, imaginary evils involved in my being alive. *supervise,*—first reading, verb used for noun, like 'remove' for removal. *statists,*—statesmen. *yeoman's service,*—such service as the yeomen or small freeholders rendered in war time, that is faithful and efficient service. *comma,*—a point marking connection, as opposed to a period or full stop. Staunton agrees with some other critics in thinking the word a misprint, and suggests 'co-mate.' *know,*—knowledge. *shriving-time,* time for confession, a short time. *ordinant,*—for ruling, ordaining. *pass and fell-incensed points of mighty opposites,*—thrust and cruelly-directed weapons of mighty adversaries. *Does it not stand me now upon,*—'Is it not incumbent on me?' *quit him,*—pay him off, requite him. *chough,*—a kind of jackdaw frequenting the coast. *indifferent,*—rather, compare 'indifferent honest.' *card or calendar of gentry,*—guide to gentle manners; 'by the card.' *continent,*—that which contains. *yet but yaw,*—Staunton suggests 'wit would but yaw' or move unsteadily like a ship not answering her helm. *his semblable is his mirror,*—there is nothing like him but his image in a mirror. Osric's language and Hamlet's mimicry of it satirize the affected speech of courtiers who were that and nothing more. *in his meed he's unfellowed,*—in his merit he is without an equal. *imponed*—staked. *edified by the margent,*—instructed by marginal notes. *german,*—for germane, akin, fitting. *liberal-conceited carriages,*—lavishly designed hangers or straps to suspend the weapons. *breathing-time,*—time for exercise. *did comply,*— was ceremonious, paid compliments. *gaingiving,*—misgiving; 'gain' is from against, as in *gainsay, gainstand. forestal their repair,*—prevent their coming. *special providence in the fall of a sparrow,* see Matthew x., 29. *His madness,*—the madness he had assumed, and was bound still to keep up before the king; and, at the same time, the mental excitement which amounted almost to real madness. *disclaiming,*—disavowal of intention. *stick fiery off,*—show brilliantly. *quit,*—as used above, pay him off. *an union,*—'a pearl of faultless beauty,' the name *unio* for a perfect pearl has been regarded as meaning *unique*; it has also been explained as meaning a solitary pearl, with no others set round it. 'Pliny tells the story of Cleopatra dissolving a pearl in vinegar and drinking it off to win a bet of Antony.' *kettle,*—kettledrum. *scant of breath,*—said to be a playful allusion to the stoutness of Richard Burbage, the actor, who first took the part of Hamlet. *napkin,*—handkerchief. *make a*

wanton of me,—trifle with me. *fell sergeant*,—cruel sheriff's officer. *occurrents*,—incidents, 'things that have occurred.' *solicited*,—prompted. *this quarry cries on havoc*,—this heap of slain seems to call for further slaughter with no quarter given, that is to those who have caused the disaster; 'quarry' means dead game. *jump*,—exactly. *rights of memory*,—rights which are remembered. *rites of war*,—burial with such honours as were given to those slain in battle. On this Mr. Moberly beautifully says: 'Late, and under the strong compulsion of approaching death, he has done, and well done, the inevitable task from which his gentle nature shrank. Why then any further thought, in the awful presence of death, of crimes, conspiracies, vengeance? Think that he has been slain in battle, like his sea-king forefathers; and let the booming cannon be his mourners.'

The play of Hamlet was probably based on an earlier play on the same subject, the materials of which ware gathered from the Danish History of Saxo Grammaticus, who lived in the latter half of the 12th century and early part of the 13th. The story of Hamlet with some others was incorporated in Belleforest's Histoires Tragiques and printed at Paris in 1570. The first edition of Shakespeare's play appeared in 1603, and was followed in 1604 by the second quarto which differed from the first in many points, but especially in being considerably extended. It has been conjectured that the edition of 1603 was printed from notes hastily written down during the performance, or privately obtained from the actors, and that the edition of 1604 represented the genuine work of the author.

Mr. Stopford Brooke, reading into the plays of the great dramatist the influences of his actual life, considers that the tragedies of Julius Cæsar and Hamlet were the outcome of a serious change in the life and mind of Shakespeare. He had been a successful man in the last few years of the sixteenth century, and had grown wealthy, famous, and a favourite in the best literary society. 'Suddenly all his life seems to have grown dark. His best friends fell into ruin. . . . Disgust of his profession as an actor, and public and private ill weighed heavily on him, and in darkness of spirit, though still clinging to the business of the theatre, he passed from comedy to write of the sterner side of the world, to tell the tragedy of mankind.' 'Hamlet, the dreamer, may well represent Shakespeare as he stood aside from the crash that overwhelmed his friends, and thought on the changing world.'

But whatever may be thought of Mr. Stopford Brooke's particular view, no thoughtful student of the play can fail to recognise the remarkable character of the tragedy, and to be impressed with the marvellous interest that clings to the chief personage. Hamlet is not merely a history and a tragedy; it is in some measure a practical essay in mental philosophy.

Schlegel, the great German critic, says 'Hamlet is a tragedy of thought, inspired by continual and never-satisfied meditation on human destiny and the dark perplexity of the events of this world, and calculated to call forth the very same meditation in the minds of the spectators. . . . The whole is intended to show that a calculating consideration, which exhausts all the relations and possible consequences of a deed, must cripple the power of acting.'

The character of Hamlet has been a fascinating subject for discussion, and the criticism of Shakespearian scholars has been extremely diverse; but perhaps no one has gone more to the heart of the question than S. T. Coleridge. He believes 'the character of Hamlet may be traced to Shakespeare's deep and accurate science in mental philosophy. Indeed, that this character must have some connection with the common fundamental laws of our nature, may be assumed from the fact that Hamlet has been the darling of every country in which the literature of England has been fostered. In order to understand him it is necessary that we should reflect on the constitution of our own minds. . . . In Hamlet, he (Shakespeare) seems to have wished to exemplify the moral necessity of a due balance between our attention to the objects of our senses, and our meditation on the workings of our minds,—an *equilibrium* between the real and the imaginary worlds. In Hamlet this balance is disturbed; his thoughts and the images of his fancy are far more vivid than his actual perceptions; and his very perceptions, instantly passing through the medium of his contemplations, acquire, as they pass, a form and a colour not naturally their own. Hence we see a great, almost an enormous, intellectual activity, and a proportionate aversion to real action consequent upon it, with all its symptoms and accompanying qualities. This character Shakespeare places in circumstances under which it is obliged to act on the spur of the moment. Hamlet is brave and careless of death; but he vacillates from sensibility and procrastinates from thought, and loses the powe- of action in the energy of resolve. The effect of this overr balance of the imaginative power is beautifully illustrated in the everlasting broodings and superfluous activities of Hamlet's mind, which, unseated from its healthy relation, is constantly occupied with the world within, and abstracted from the world without—giving substance to shadows, and throwing a mist over all common-place actualities. He mistakes the seeing his chains for the breaking them; delays action till action is of no use; and dies the victim of mere circumstance and accident.'

Goethe treats of the play at considerable length in 'Wilhelm Meister's Apprenticeship,' and quoting the couplet—

> 'The time is out of joint: O cursed spite,
> That ever I was born to set it right.'

goes on to say, 'In these words, I imagine, will be found the key to Hamlet's whole procedure. To me it is clear that Shakespeare meant, in the present case, to represent the effects of a great action laid upon a soul unfit for the performance of it. There is an oak-tree planted in a costly jar, which should have borne only pleasant flowers in its bosom—the roots expand, the jar is shivered. A lovely, pure, noble, and most moral nature, without the strength of nerve which forms a hero, sinks beneath a burden which it cannot bear, and must not cast away. All duties are holy for him; the present is too hard. Impossibilities have been required of him,—not in themselves impossibilities but such for him. He winds, and turns, and torments himself; he advances and recoils; is ever put in mind, ever puts himself in mind; at least does all but lose his purpose from his thoughts; yet still without recovering his peace of mind.'

Schlegel forms a less favourable opinion of the character than Goethe. 'He is, it is true, of a highly cultivated mind, a prince of royal manners, endowed with the finest sense of propriety, susceptible of noble ambition, and open in the highest degree to an enthusiastic admiration of that excellence in others of which he himself is deficient. He acts the part of madness with unrivalled power, convincing the persons who are sent to examine into his supposed loss of reason, merely by telling them unwelcome truths, and rallying them with the most caustic wit. But in the resolutions which he so often embraces, and always leaves unexecuted, his weakness is too apparent; he only does himself justice when he implies that there is no greater dissimilarity than between himself and Hercules. He is not solely impelled by necessity to artifice and dissimulation, he has a natural inclination for crooked ways; he is a hypocrite towards himself; his far-fetched scruples are often mere pretexts to cover his want of determination; thoughts, as he says on a different occasion, which have 'but one part wisdom, and ever three parts coward.' Hamlet has no firm belief either in himself or in anything else; from expressions of religious confidence he passes over to sceptical doubt.'

The student will probably have formed a more favourable judgment of Hamlet than Schlegel's, but every one must admit that the central point of weakness is the lack of balance between the powers of thought and outward action. He is ever 'considering too curiously' and 'thinking too precisely on the event.' Professor Dowden's view of Hamlet is similar to that of Goethe, and he seems to regard the manifest weakness of character as almost entirely due to his environment. 'All the strength which he possesses would have become organised and available had his world been one of honesty, of happiness, of human love. But a world of deceit, of espionage, of selfishness surrounds him; his idealism at thirty years of age almost takes the form of pessimism; his life and his heart become sterile; he loses the energy which sound and joyous feeling supplies.'

These various criticisms are placed before the student in the hope that they will enable him to understand the spirit and purpose of this great drama, that with an intimate knowledge of the text he will be able to verify or to correct the opinions expressed, and to make them, when thus checked, his own.

A writer who has made a minute study of the play, thus sums up Hamlet's character, 'Hamlet is a noble, generous, high-souled, and brave man. He has all the accomplishments, education, and refinement of a gentleman; and is a prince not merely by rank, but also by reason of the nobleness of his character. But all these ornamental qualities are not enough to make the Hamlet of this play. More are needed, and these are—tenderness and devotion, remarkable insight and ability shown both in thought and word, love of truth, dashing energy, courage, and—above all—self-control and uncomplaining self-sacrifice.' In a very complete analysis of the play this author proceeds to verify his summary by specific quotations from the play. The endeavour to do this for himself would be an excellent exercise for the student.

The analysis just referred to also contains various arguments on the question whether Hamlet's madness was only feigned or was it real. Eighteen medical and nine general arguments are adduced in favour of regarding Hamlet as really mad, while seventeen general and no medical arguments are urged in favour of his sanity; but to us it seems that Hamlet's sanity, 'as this world goes,' at any rate, should be beyond question. The search for passages seeming to corroborate these opposite views would form another good exercise.

Of the other characters we have room for few words only. Coleridge has spoken of Ophelia as 'the sweetest phantom that ever wailed her woes in the hearing of a poet's brain.' Another writer says 'Ophelia is a pure and noble angel. As a daughter she is obedient and affectionate. As a lover, she is forgiving, devoted, and dignified. Hers is a tender, pliant and submissive, rather than a clever, incisive, and independent mind.'

'The queen is a woman who has fallen before the arts of a clever, able, and fascinating man.' She appears to have a large share of that weakness of will which caused so much trouble to her son.

Laertes is a young man of the world, with no great depth of knowledge, nor loftiness of character. He is hasty, 'full of sound and fury,' with abundant energy, and physical courage. His treachery to Hamlet, and his love for his sister, may be set off against each other.

Polonius is marked by conceit, pedantry, worldly-wisdom, with a low moral standard. As Johnson says, he was 'knowing in retrospect, and ignorant in foresight.'

Horatio is a faithful friend, devoted to Hamlet, honest and helpful. He says little, but never fails in duty. Weiss says, 'He is a continent, upon which Hamlet finds that he can securely walk, the only domain in Denmark that is not honeycombed with pitfalls.'

(The end.)

Query Column.

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher, Pilgrim Street, Ludgate Hill, London, E.C.*

Mensuration.

1. H.M.—A sphere, whose radius is 4 eet 6 inches, is divided into three parts of equal height by two parallel planes; find the volume of each part. (*Lewis.*)

Rule for Volume of Segment of Sphere:—From three times the diameter of the sphere deduct twice the height of the segment; multiply the remainder by the square of the height, and that product by ·5236; the last product will be the solidity.

Height of each part = ⅓ of 9 ft. = 3 ft.;
Volume of each end part
= $[\{(4\frac{1}{2} \times 2 \times 3) - (3 \times 2\} \times 3^2 \times \cdot 5236]$ cub. ft.
= $\{(27 - 6) \times 9 \times \cdot 5236\}$ cub. ft.
= $(21 \times 9 \times \cdot 5236)$ cub. ft.
= $(\cdot 5236 \times 189)$ cub. ft.
= 98·9604 cub ft.

Volume of sphere = $(9^3 \times \cdot 5236)$ cub. ft.
= $(\cdot 5236 \times 729)$ cub. ft.;
∴ Volume of middle part
= $[\cdot 5236 \times \{729 - (189 \times 2)\}]$ cub. ft.
= $\{\cdot 5236 \times (729 - 378)\}$ cub. ft.
= $(\cdot 5236 \times 351)$ cub. ft.
= 183·7836 cub. ft.

2. R. FISH.—If a cylinder, whose length is l and diameter d, has a weight w, what will be the weight of a cylinder of the same material, whose length is l_1 and diameter d_1? (*Atkins.*)

Cubical content of 1st cylinder = $d^2 \times \cdot 7854 \times l$,
" " 2nd " = $d_1^2 \times \cdot 7854 \times l_1$;
∴ Weight of 1st cylinder : Weight of 2nd cylinder
:: $d^2 \times \cdot 7854 \times l : d_1^2 \times \cdot 7854 \times l_1$
:: $ld^2 : l_1d_1^2$;
∴ $ld^2 : l_1d_1^2 :: w$: Weight of 2nd cylinder,
∴ Weight of 2nd cylinder = $\frac{l_1d_1^2}{ld^2} w$.

Algebra.

1. JOSEPHUS.—At simple interest, the interest on a certain sum of money is £180, and the discount on the same sum for the same time and at the same rate is £150; find the sum. (*Todhunter.*)

Let M denote the amount in pounds, I the interest, D the discount, r the interest of one pound in one year, and n the number of years.

Then, $I = M\,nr$,
$D = \frac{M\,nr}{1 + nr}$;
∴ $M\,nr = 180$
$\frac{M\,nr}{1 + nr} = 150$
$\frac{180}{1 + nr} = 150$,
$\frac{120}{120} = 1 + nr$,
$\frac{6}{5} = 1 + nr$,
∴ $nr = \frac{1}{5}$;
$M\,nr = 180$,
$M \times \frac{1}{5} = 180$,
∴ $M = 180 \times 5 = 900$
∴ Sum = £900.

Note.—This question can be easily solved by Arithmetic.

The difference between the simple interest and discount is the simple interest on discount.

£ £ £
180 : 150 :: 30 : Interest on £100 for the same time at the same rate.
= £20.

£ £ £
∴ 20 : 180 :: 100 : Sum
9
= £900. Ans.

2. W. B.—Cannon balls are piled in a regular square-based pyramid, one ball at the top and 121 in the layer lying on the ground. What is the average number of balls in each layer?
(*Moffatt's* 'P. T. Year Book.')

No. of balls in a side of the bottom layer $= \sqrt{121}$
$= 11$;
$\therefore$ No. of layers $= 11$.
$\therefore$ No. of balls $= 1^2 + 2^2 + 3^2 + \ldots + 11^2$
$= \frac{11\,(11+1)\,(2\times 11+1)}{6}$
$= \frac{11\times 12\times 23}{6}$
$= 11\times 2\times 23$;
$\therefore$ Average number of balls in a layer $= \frac{11\times 2\times 23}{11}$
$= \underline{46}$. Ans.

3. T. C. JOTCHAM.—A man inheriting money spends on the first day 19s., twice that amount the next day, and 19s. additional every day till he exhausts his fortune by spending on the last day £190. What did he start with?
(*Moffat and Paige's* 'P. T. Course, 4th Year.')

This is a question in Arithmetical Progression, where a (first term) $= 19$s., d (difference) $= 19$s., l (last term) $= 3{,}800$s., and s (sum) is required.

Let n = number of terms,
Then, $l = a + (n-1)\,d$,
$3{,}800 = 19 + [(n-1)\times 19]$
$= 19 + 19n - 19$,
$19n = 3{,}800$,
$\therefore\ n = 200$.

$S = (a+l)\frac{n}{2}$
$= (19 + 3{,}800)\times \frac{200}{2}$
$= 3{,}819\times 100$
$= 381{,}900$.
$\therefore$ Sum $= 381{,}900$s.
$= \underline{£19{,}095}$. Ans.

4. CRUX.—The distance between two towns is such that it takes a coach p hours going at the rate of a miles an hour to do the distance; and walking b miles an hour, it will take me q hours.

How long must I start before the coach overtakes me, that, by getting on it when it overtakes me, I may get over the distance between the towns in half the time it would have taken me to walk it? *(College of Preceptors.)*

Distance between the two towns $= ap$ miles, or bq miles.

Let x = time in hours,

Then, bx = distance walked in miles when overtaken by coach,

And $\frac{ap-bx}{a}$ or $\frac{bq-bx}{a}$ = time in hours taken by coach to travel the remaining distance;

$\therefore\ x + \frac{ap-bx}{a} = \frac{q}{2}$; or, $x + \frac{bq-bx}{a} = \frac{q}{2}$

$ax + ap - bx = \frac{aq}{2}$; or, $ax + bq - bx = \frac{aq}{2}$

$ax - bx = \frac{aq}{2} - ap$; or, $ax - bx = \frac{aq}{2} - bq$

$(a-b)\,x = \frac{a\,(q-2p)}{2}$, or $\frac{q\,(a-2b)}{2}$

$\therefore\ x = \frac{a\,(q-2p)}{2\,(a-b)}$, or $\frac{q\,(a-2b)}{2\,(a-b)}$.

$\therefore$ I must start $\frac{a\,(q-2p)}{2\,(a-b)}$ hours, or $\frac{q\,(a-2b)}{2\,(a-b)}$ hours, before the coach.

NOTE.—The two expressions give the *same* time.

Arithmetic.

1. FRANK.—Find the cube root of 111423515328.

111'423'515'328(4,812
64
$4^2\times 300 = 4800$ | 47423
$4\times 8\times 30 = 960$
$8^2 = 64$
5824 | 46592
$48^2\times 300 = 691200$ | 831515
$48\times 1\times 30 = 1440$
$1^2 = 1$
692641 | 692641
$481^2\times 300 = 69408300$ | 138874328
$481\times 2\times 30 = 28860$
$2^2 = 4$
69437164 | 138874328

$\therefore$ Cube Root $= \underline{4{,}812}$.

2. MARY.—The stuff out of a lead mine at first contains 15·9 per cent. of lead. After washing, by which process the amount of lead is not diminished, the stuff contains 87·45 per cent. of lead. How much rock was washed away out of 216 tons 5 cwt. of the original stuff? *(Davis.)*

Quantity of lead $= 15{\cdot}9\,\%$ of $216\frac{1}{4}$ tons.
$= \left(\frac{159}{1000}\times\frac{173}{4}\right)$ tons
$= \frac{27507}{800}$ tons;

Quantity of rock left
$= \frac{100-87{\cdot}45}{87{\cdot}45}$ of $\frac{27507}{800}$ tons
$= \left(\frac{1255}{8745}\times\frac{173}{27507}\right)$ tons
$= \frac{43423}{8800}$ tons;

$\therefore$ Quantity of rock washed away
$= 216\frac{1}{4}$ tons $- \left(\frac{27507}{800} + \frac{43423}{8800}\right)$ tons
$= 216\frac{1}{4}$ tons $- \frac{302577 + 43423}{8800}$ tons
$= 216\frac{1}{4}$ tons $- \frac{346000}{8800}$ tons
$= 216\frac{1}{4}$ tons $- 39\frac{4}{11}$ tons
$= 216$ tons 5 cwt. $-$ 39 tons 6 cwt. 1 qr. $12\frac{8}{11}$ lbs.
$= 176$ tons 18 cwt. 2 qrs. $15\frac{3}{11}$ lbs. Ans.

Or,—

Percentage of rock left $= \frac{100-87{\cdot}45}{87{\cdot}45}$ of 15·9
$= \frac{1255}{8745}\times\frac{159}{10}$
$= \frac{251}{1749}$

Total percentage left $= \frac{159}{10} + \frac{251}{1749}$
$= \frac{1749+251}{110}$
$= \frac{2000}{110}$
$= \frac{200}{11}$;

Quantity of original stuff left $= \frac{2}{11}$,
$\therefore$,, rock washed away $= \frac{9}{11}$ of $216\frac{1}{4}$ tons
$= 1{,}946$ tons 5 cwt. $\div$ 11
$= \underline{176 \text{ tons } 18 \text{ cwt. } 2 \text{ qrs. } 15\frac{3}{11} \text{ lbs.}}$ Ans.

3. J. T. W.—A boy climbed up $\frac{4}{9}$ of a pole, and then found that there was still a length of 46 ft. above him. Find the entire length of the pole, supposing $\frac{1}{12}$ to be embedded in the ground.

$$\text{Part remaining} = 1 - (\tfrac{4}{9} + \tfrac{1}{12})$$
$$= 1 - \frac{15 + 2}{24}$$
$$= 1 - \tfrac{17}{24}$$
$$= \tfrac{7}{24};$$
$$\therefore \text{Length of pole} = 46 \text{ ft.} \times \tfrac{24}{7}$$
$$= 157\tfrac{5}{7} \text{ ft. Ans.}$$

General.

Will the correspondent who sent the Question on Trilinear Co-ordinates kindly repeat his query, which by an oversight has been mislaid.

1. MORAY HOUSE.—Thanks for solution. You did not say that the direct proof must not involve any subsequent propositions.

2. C. H.—It is best to send one specimen of large and one of small hand. The value of the two copies of large hand is about the same. The capitals are well formed. The shapes are good and the joinings accurately done. There is an appearance of effort about it. It is stiff and lacks grace. It is good and promises well. The other copies are all very inferior. There is not a single good capital letter among them, and scarcely any of the letters will bear examination. The word commendable is perhaps the worst as it embodies nearly all the faults to be guarded against.

3. M. FIELD.—You would do well to buy a 'Code of regulations,' which contains all the information you can require. It is published annually and can be had of any bookseller for a few pence. We presume you mean what will qualify one to teach, or be a head-teacher, or an assistant. You will see that while it is very desirable to enter a training college, it is not at present necessary. But whether teachers go to training colleges or not the examinations they have to undergo are of the same kind and difficulty. We shall be glad to give you any further help you may require.

4. HAMLET.—Large hand 75, small hand 80. The large hand is too upright, and the curves are not easy and elegant. The small hand is too large. The capitals are not so good as the small letters. Special attention should be paid to the loops.

5. R. G. T.—*De Morgan's* 'Arithmetic' is excellent for a teacher. *Barnard Smith's* has had a large circulation, so has *Colenso's*. All are well known, there are many others. The reference to page 24, 1885, is quite correct.

6. A PUPIL TEACHER.—The method of parsing *can* as an auxiliary was much in use 20 years ago, chiefly through the influence of *Morell's* 'Grammar,' which had a wide circulation. But authority now is pretty unanimous in taking *can* as the principal verb. This is in accordance with the practice in French and German. The objection you name is not one really. I go is not the same as I can go. The one denotes the fact of my going, the other my ability to go if I like. There is no more reason for treating can as an auxiliary in I can go, than there is for treating dare as an auxiliary in I dare go. The old way is gradually dying out. The pamphlet is only a small sum.

7. X.—The writing is good, it has most of the qualities required, but could be improved in the matter of ease and elegance of the curves.

8. DYKE.—Peterborough is in the eastern division of the Education Department. The passage you sent means that the strength of one was great and the riches were great of another.

9. A. E.—Yes, you could expect to pass in the first class, You should get the questions set last year and study them. Then you should decide at what College you would like to sit next July and apply to the secretary of it for permission to do so. If you want any further information write again to us.

Thank you for your suggestion. You can however always get what you require by sending a piece to us. We think next March would be time enough but we do not know.

10. M. H.—Name only. See rule 2.

11. THREE YEARS' SUBSCRIBER.—Express in the scale of seven the numbers which are expressed in the scale of ten by 231 and 452: multiply the numbers together in the scale of seven and reduce to the scale of ten.

7)231
)33
4···5

No. = 450

7)452
7)64···4
7)9···1
1···2

No. 1214

1214 × 450
12140
45
64060
5162
10)613260
10)42304.. 2
10)3021···1
10)206···4
10)13···4
1···0

No. = 104412

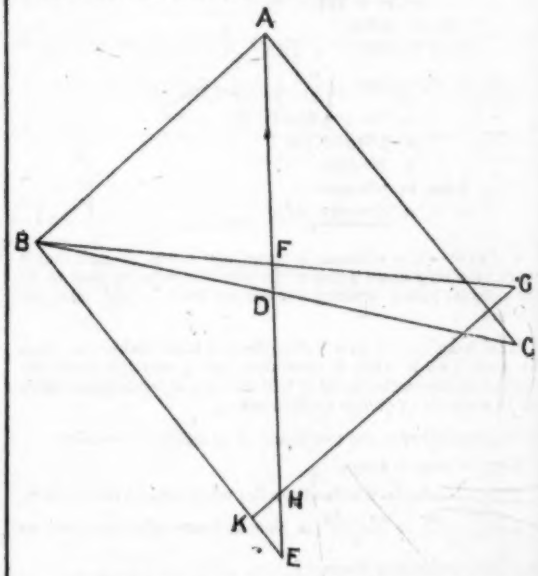
Find in what scale 16,000 is denoted by 1,003,000.

Let x = radix, then $16000 = x^6 + 3x^3$
$\therefore 16002\tfrac{1}{4} = (x^3 + \tfrac{3}{2})^2$
$\therefore x^3 + \tfrac{3}{2} = 2\tfrac{1}{2}$
whence $x = 5$

Geometry.

1. MORAY HOUSE.—Give a direct proof of Euclid I. 19. (*Casey's* 'Sequel to Euclid.')

(The following proof does not involve I. 20.)



In the triangle ABC let the angle ABC be greater than the angle ACB.

Bisect BC in D. (I. 10.)

Join AD, and produce it to E, making DE = DA. (I. 3)

Join BE.

In triangles BDE, ADC,
Sides BD, DE = Sides CD, DA (Con.)
$\angle$ BDE = $\angle$ CDA (I. 15.)
$\therefore$ Base BE = Base CA (I. 4.)
And $\angle$ EBD = $\angle$ ACD;
But $\angle$ ABC is greater than $\angle$ ACB (Hyp.)
$\therefore$ $\angle$ ABC is greater than $\angle$ EBC.

Bisect $\angle$ ABE by BF, meeting AE in F (I. 9); BF will fall within the $\angle$ ABC.

Produce BF to G, making FG = FB.

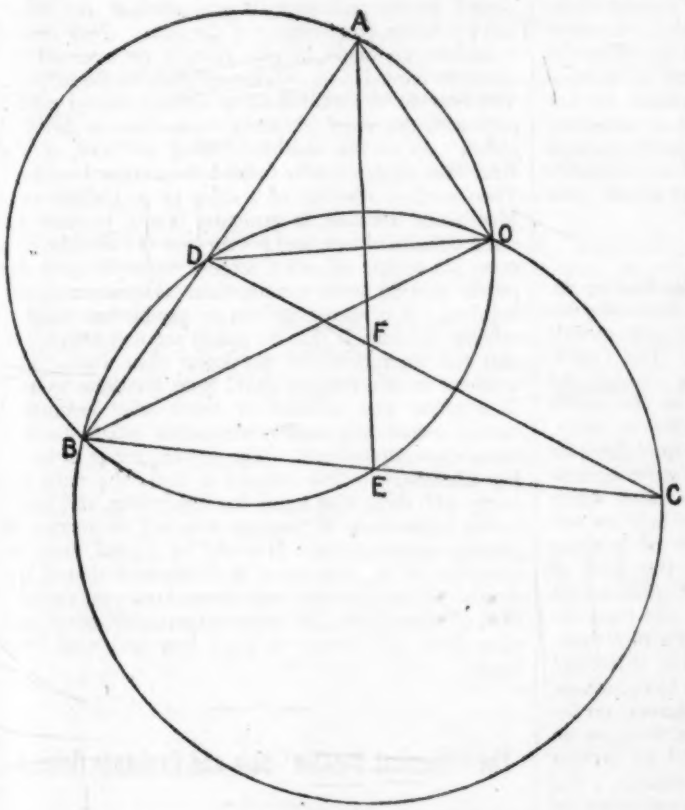
From FE cut off FH = FA. Join GH, and produce it to meet BE in K.

In triangles GFH, BFA,
Sides GF, FH = Sides BF, FA, (Con.)
$\angle$ GFH = $\angle$ BFA (I. 15.)
$\therefore$ Base GH = Base BA (I. 4.)
And $\angle$ FGH = $\angle$ FBA
= $\angle$ FBK;

Wherefore triangle KBG is isosceles,
And KG = KB (I. 6.);
But BE is greater than BK,
And AC has been proved to be equal to BE,
$\therefore$ AC is greater than GK;
But GK is greater than GH,
And GH has been proved to be equal to AB,
$\therefore$ GK is greater than AB;
Much more therefore is AC greater than AB.

Q. E. D.

2. D. CREIG.—If four straight lines intersect one another so as to form four triangles, prove that the four circumscribing circles will pass though one point. *(Glasgow Bursary Competition.)*



Let DBEF be a quadrilateral, and let the sides BD and EF produced meet at A, and BE and EF produced meet at C.
About the triangles ABE, CBD, describe circles. (IV. 5.)
Draw the common chord BO, and join AO, DO.

Proof.—
$\angle$AOB = $\angle$AEB, (III. 21.)
$\angle$AOB = $\angle$AOD + $\angle$BOD,
$\angle$AEB = $\angle$BCD + $\angle$EFC, (I. 16.)
= $\angle$BCD + $\angle$DFA, (I. 15.)
= $\angle$BOD + $\angle$DFA, (III. 21.)
$\therefore$ $\angle$AOD = $\angle$DFA; (Ax. 3.)

If circles be described about triangles AOD, AFD, the circumferences of both will pass through O and F. (Converse of III. 21.)
Similarly it can be proved that the circle described about triangle EFC passes through O.
$\therefore$ The four circumscribing circles pass through the point O.

Q. E. D.

(The other queries will appear next month.)

Science Notes.

MR. A. E. TUTTON has called attention in a recent number of *Nature* to the latest great contribution to chemical science. Glucose, commonly known as grape sugar, has at last been synthesised in the laboratory of Würtzburg. Not only has a most important substance been prepared in the laboratory which up to the present time has been the result of the functions of plant life, but a good deal of light has been thrown upon the constitution of the sugars themselves. Mr. Tutton says there have been two pretty evenly balanced hypotheses as to the constitution of the sugars. According to one, sugars are considered in virtue of their power of reducing ammoniacal silver solutions as aldehydes containing also alcohol groups. On these lines grape sugar would be written $CH_2OH—(CHOH)_4—CHO$. But it has been shown that the property of reducing ammoniacal silver solutions is not confined to aldehydes, for the series of bodies known as ketones also possess it, hence grape sugar may also be written $CH_2OH—(CHOH)_3—CO—CH_2OH$. As the synthesis of sugar was made by starting from acroleïn, which is itself an aldehyde, the probability that the sugars are really aldehydes is much increased. It is almost certain that glycerine aldehyde $CH_2OH—CHOH—CHO$ is formed and two molecules of this appear to unite and form a molecule of sugar. In memory of its mode of preparation the name acrose has been applied to it by Dr. Fischer and Dr. Tafel, to whom the honour of this new addition to chemical knowledge is due.

* * *

IT is well known that there is a great waste of energy in converting one form of it into another. If we start with the potential energy of coal and transform it into that of heat, and then into that of, say a moving wheel, and then into that of an electric current, and finally into that of another moving wheel, the waste is enormous. This, however, is the method at present adopted. The current thus generated is used to produce the electric light or to turn machinery. Attempts are now being made, indeed it is said that they have already been successfully made, to prevent much of this waste, and to convert heat more economically into the other and more useful forms of energy. Mr. Edison has invented and constructed an engine which by means of hot air acting upon a magnet produces a motion of rotation of 120 revolutions per minute. He is now building one of these pyro-magnetic motors calculated to work at three horse power. He has also constructed a pyro-magnetic dynamo, which by essentially the same means generates an electric current, which will be available for electric lighting. It will be seen that the effect of this invention, should it prove successful, will be to eliminate one stage of the present mode of producing a current for the purpose of electric lighting, and for the transmission of electrical energy.

THE Committee of the British Association have issued a long and valuable report on the teaching of science in elementary schools. They have quoted the evidence of the inspectors and others who have been examined before the Royal Commission, and also referred to the growth of public opinion upon the subject. Notice is also taken of the successful attempts made in various parts of the country to meet the requirements of at least a beginning in a great work. With reference to the question how far can elementary science be taught in elementary schools the evidence laid before the Royal Commission went to prove that not only was a knowledge of ordinary phenomena of importance but that it should be made a necessary part of the school programme. The opinion is becoming general that the absolute preference now given to English as a class subject should be abolished and the choice thrown perfectly open. The last paragraph of the report is worth quoting. 'From a review of the present situation it would appear that the action of the Education Department tends positively to frustrate the efforts of those who desire to increase the teaching of Science in Elementary Schools; but the committee do not believe that it is the intention of those in authority, and feel sure that the great advance in public opinion will ultimately lead to a knowledge of the elements of Science being made an essential part of all State aided Education.'

***

THE subject of Geography is decidedly looking up. It will be remembered that about the year 1869 the Royal Geographical Society decided to give medals to successful students in public schools. The experiment met with very indifferent success. Geography was not a subject which the teachers in the public schools had either the wish or the ability to teach. The consequence was that there were few candidates for the Society's prizes, and as a rule they were exceedingly badly prepared, except in a few cases where special attention had been given to a few boys at one or two institutions with the express view of winning the medals. As a means of raising the level of geographical teaching of the country the effort was an acknowledged failure. During the past few years the Society has made a fresh start, and in two directions. As the public schools showed themselves indifferent to the well meant attention of the Royal Geographers, they have now resolved to bestow their favours on the students in training colleges, and also, let us hope, on that faintly praised though useful and at present necessary class of persons the pupil teachers. But the Society has not only sought new candidates for its medals, it has also set itself seriously to work to produce a better set of text books. Professor Geikie has already published the first instalment of a rather ambitious series of 15 volumes. His volume on the teaching of Geography will no doubt be carefully read by all who have a love for the subject and wish to keep themselves abreast the ideas of those who have made Geography and kindred subjects the study of their lives.

***

A distinguished Cambridge lecturer read a paper before the British Association, at Manchester, on the teaching of Chemistry. It is a very thoughtfuf and suggestive essay. We will quote a few sentences and make a few remarks. 'In teaching Chemistry the all-important things appear to me to be chiefly four:—(1) to teach so that the student shall acquire real knowledge;' (2) to carefully select both the facts and the reasoning to be set before the student; (3) to impress the learner with the importance and value of what he is learning as a part of that orderly and methodized study of nature which we call science; (4) to teach without fear of the examiner.' 'Finally, I think that the fear of the examiner acts very prejudicially on the chemical teaching of this country. He is not so very terrible a person as some teachers suppose. Not unfrequently he is a foolish person who knows but little Chemistry and has recourse to text books for good tips.' We recommend the paper to the consideration of teachers of Chemistry. There can be no doubt that it will be impossible much longer to continue upon the old lines. In Botany and Zoology it has been found impossible to study all the forms; typical plants and animals are studied in detail, and are taken as specimens of the rest. Why should a student be made, in one year, to go over all the elements named in an ordinary syllabus on the subject? Teachers can do nothing till a change comes and it rests with the chief chemists themselves to bring it about. As to the teachers taking no heed of the Examiner we can hardly believe the author is serious. The teacher, whether of a class in a College or a Mechanics' institute, is generally bound to work for some definite object, and his success as a teacher, nay, even his tenure of office, largely depends upon his pupils passing some examination. He is practically helpless. It is no use for him to say he has made a syllabus for himself, that his pupils are well instructed, that the examiners did not know their work. Few teachers in this country could long continue to hold their office who refused to teach what examining boards asked for, and consequently what students came expressly to learn. The present mode of teaching Chemistry in this country is bad; the fault lies partly with those who frame the regulations, and partly in the importance at present attached to success in passing examinations. It would be a good thing for education in this country if, in commemoration of the year of Jubilee, teachers were allowed one year's respite from all inspections and examinations whatsoever, and were given full liberty to teach how and what they liked.

—o—

The 'Practical Teacher' Sale and Exchange Column.

What Offers?—360 Voluntaries (Elliot), by best composers, one vol. 8s.; Bach's Grand Organ Studies, 3 staves, 10s. 6d.; Key to Barnard Smith's 'Arithmetic,' 8s.; 'Initia Græca,' 3s. 6d.; Cassel's 'Lessons in French,' 3s. 6d.; Blackie's 'World as it is,' first seven volumes, 14s.; Cassell's 'Science for All,' 48 numbers, 28s.; all good as new.—Schoolmaster, National School, Ardingly, Hayward's Heath.

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The Madras Journal of Education. October.

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A Little Stepdaughter.

Answers to Pupil Teachers' Examination Questions.

15TH OCTOBER, 1887.

Geography.

Males and Females.

FIRST YEAR.

(*Answer three questions only.*)

1. Draw a map of the six Northern counties of England, marking the seaports, and the positions of Manchester, Leeds, Sheffield, Bradford, Oldham, Blackburn, and Durham.

2. Enumerate the five Colonies of Australia, with their chief towns. Describe the climate of one of them, its form of government, and its chief productions.

3. Name the principal seaports of Scotland and of Ireland, describing their positions and the character of their industries.

4. Describe a journey from Liverpool to Vancouver's Island, crossing America by the Canadian Pacific Railway.

2.

The five Colonies of Australia are:—

(1.) Victoria; chief towns—Melbourne, Geelong, Ballarat, Sandhurst, Castlemaine, Portland.

(2.) New South Wales; Sydney, Maitland, Goulburn, Grafton, Newcastle, Paramatha, Windsor, Albany, Bathurst, Port Macquarie.

(3.) Queensland; Brisbane, Ipswich, Rockhampton, Maryborough, Townsville.

(4.) South Australia; Adelaide, Burra Burra, Kapunda, Gawler, Kooringa.

(5.) West Australia; Perth, Freemantle, Albany, Geraldton.

Victoria occupies the south eastern corner of the colony, and stretches furthest into the temperate zone. Its climate is much milder than that of England and may be described as dry and healthy, its mountain ranges moderating the climate to some extent. Like other parts of Australia it is sometimes troubled with long droughts. Its chief productions are gold, wool, wheat, flour, live stock, which are exported to the amount of nearly £15,000,000 annually. The Government is invested in a Governor appointed by the crown, aided by an Executive Council of 10 members, and a parliament consisting of a Legislative Council of 40 members, and a Legislative Assembly of 86 members.

3. The principal seaports of Scotland are Glasgow, on the Clyde, noted for shipbuilding, cotton manufacture, coal, and iron; Greenock, on the Clyde, shipbuilding and sugar refining; Ardrossan, trade with Ireland; Irvine, shipbuilding; and Ayr, export of coal, iron, and agricultural produce—all in the Firth of Clyde. On the east coast there are Leith, the port of Edinburgh, on the Firth of Forth, engineering and shipbuilding; Dundee, on the Tay, whaling port, manufacture of linen, and shipbuilding; Montrose, shipbuilding and linen; Aberdeen, at the mouth of the Dee, export of granite, woollens, shipbuilding; Peterhead, export of granite; Wick, the largest fishing port in the north of Scotland. Smaller ports are Stornoway, in Lewis; Portree, in Skye; Inverness, on the Moray Firth; Arbroath, in Fife.

The chief ports in Ireland are Belfast, on Belfast Lough, noted for linen and shipbuilding; Cork, on Cork Harbour, export of cattle and provisions; Limerick, on Shannon, lace, tobacco, provisions; Londonderry, on Loch Foyle; Waterford, on Waterford Harbour; Wexford, on Wexford Haven; and Kingstown, the port and packet station for Dublin, on Dublin Bay.

Leaving the port of Liverpool, the vessel would sail in a southerly direction down the Irish Sea, and turning westward would call at Queenstown for the Irish mails. Some two thousand miles of ocean would then be crossed before sighting land in America. Passing south of Newfoundland we should have Nova Scotia and New Brunswick on the south as we sailed up the Gulf of St. Lawrence to Quebec or Montreal. Landing at either of these great cities we should take the rail, which passes along the banks of the great lakes almost throughout the whole of their extent, if we wish to visit Kingston, Hamilton, or Toronto, or through Ottawa direct to Fort William, on Lake Superior, if we wish to avoid these towns. The line then continues past the Lake of the Woods to Winnipeg, the capital of Manitoba, and over boundless prairies to the Rocky Mountains, which it crosses by one of the passes into British Columbia. The descent is rapid into the bed of the Fraser River to New Westminster, not far from its mouth. Crossing Queen Charlotte's Sound we reach Vancouver Island, the end of our six thousand miles journey.

SECOND YEAR.

(Answer three questions only.)

1. Draw a map (indicating latitude and longitude) of the basin of the Danube, marking the positions of Munich, Linz, Vienna, Innsbruck, Pesth, Belgrade, Sophia, Bucharest.

2. Say what you know about Agra, Bergen, Granada, Goa, Lucknow, and Trieste.

3. What are the principal productions of British India? Show the influence of climate in their variety.

4. What do you understand by latitude and longitude? How are they measured? Show that degrees of longitude vary in length.

2. *Agra*, the name of a district, division, and city of India, between the Jumna and the Ganges. The city was formerly the capital of the Mogul Empire. It has a splendid mausoleum, and a population of 140,000.

Bergen, a flourishing seaport and shipbuilding town, in a province of the same name, in the south-west of Norway, beautifully situated on a fiord, and surrounded by mountains. Population, 35,000. Exports large quantities of dried fish.

Granada, a city of south-west Spain, with a population of 70,000, the residence of the ancient Moorish kings of Spain, who built the Alhambra, considered the finest piece of Arabic architecture in the world.

Goa, a territory of India, in the Bombay Presidency, belonging to the Portuguese. Its capital, New Goa, is on an island at the mouth of the Mandora River.

Lucknow, a large city on the Goomtee, a tributary of the Ganges, north-west of Benares. Celebrated for its defence during the Indian Mutiny. Population, 280,000.

Trieste, a port of Austria, at the head of the Adriatic, on a gulf of the same name. Noted for its trade and shipbuilding.

3. The principal mineral productions of India are coal, iron, tin, copper, and lead, but they have not been much worked. Gold, silver, plumbago, nitre, salt, and borax are also found.

The animals are the tiger, lion, leopard, elephant, panther, hyæna, wolf, lynx, jackal, rhinoceros, ox, deer of various kinds, crocodiles, alligators, and venomous reptiles.

The vegetable productions are wheat, rice, millet, maize, cotton, sugar-cane, indigo, opium, coffee, linseed, jute, pepper, and spices, besides many varieties of trees.

The climate of India is extremely diversified. Although situated chiefly in the torrid zone, the inequalities of the surface serve the same purpose as differences of latitude. Consequently there are all degrees of temperature, and a great variety of vegetable productions found both in tropical and temperate climates.

4. Latitude is distance north or south from the Equator.

Longitude is distance east or west of a given meridian. In England the meridian is that of Greenwich.

They are measured in degrees, minutes, and seconds.

All meridians meet at the poles, and they cut the Equator at right angles. The various circles or parallels of latitude are smaller as they near the Equator. Every circle is divided into 360°. The smaller the circle the less the degree. Consequently a degree at the Equator, which is the largest circle, is greater than a degree measured on the parallel, say of 10°, which is smaller. And so on through all the parallels, the length of a degree of longitude varying from 69$\frac{1}{6}$ English miles at the Equator to 0 at the poles.

THIRD YEAR.

(Answer three questions only.)

1. Draw a map of Africa, south of the equator, marking the position of Durban, Delagoa Bay, Cape Town, the Mouth of the Orange River, Cape Agulhas and Zanzibar (latitude and longitude should be indicated).

2. Say all you know about Assouan, Bloemfontein, Herat, Mandalay, Suakim, Tibet.

3. Describe the course of the Nile or the Ganges.

4. How are the Trade Winds caused? Name the chief ocean currents, and describe briefly the course of one of them.

(2) *Assouan*, a frontier town of Southern Egypt, situated on the Nile, about three miles from the commencement of the cataracts, noted for its large quarries of granite, from which many obelisks have been cut. The island of Elephantine, noted for its rock-hewn temples, is near.

Bloemfontein, the largest town in the Orange River Free State, South Africa.

Herat, a strongly fortified town in the north of Afghanistan, situated in an extensive plain near the Heri-rud. A large depôt for the trade of Central Asia.

Mandalay, capital of Burmah, in further India, situated on the Irrawaddy, lately taken by the English. Population, 100,000.

Suakim, a port on the Red Sea, having a good harbour. Largely used by pilgrims for Mecca. Belongs to Egypt.

Tibet, an extensive elevated plateau north of the Himalayas, forming in great part the south-western part of the empire of China. Its mountains and plains are occupied by the early courses of several of the largest rivers of Asia. Its people have little dealings with other nations. Its climate is very dry, and in winter very cold. The yak is the chief animal of burden; the musk-deer and goat are common. Gold, silver, and other minerals are found. Its trade is considerable, its productions being bartered for tea, tobacco, and manufactured goods. Larsa is the capital.

(3) The Ganges rises on the northern side of the Himalayas, at an elevation of nearly 11,000 feet above the sea, in a cave called the Cow's Mouth. It flows for 200 miles through the chain, descending in that distance 10,000 feet, and enters the plain of India at Hurdwar. Its course is now south-east for 500 miles, when it reaches Allahabad, where it is joined by its principal tributary, the Jumna, which has flowed west of the Ganges nearly in the same direction. From Allahabad it flows eastwards for another 500 miles, and then south-east to the sea. Near Patna it receives the Sone on its right bank, while the Goomtee, Godra, and Grinduck, rising in the Himalayas, flow in on the left bank. Nearly 200 miles from the sea it separates into many channels, forming the largest delta in the world. The principal channel is the Hooghly, with Calcutta on its banks. The Brahmapootra joins the eastern branch of the river. Its total course is upwards of 1,500 miles, and its basin is upwards of 400,000 square miles. The valley is very fertile, and thickly peopled, Benares, Delhi, Agra, Moorshedabad, being other large towns.

(4.) The Trade Winds are caused by the rarefaction of the air in the heated regions of the Equator.

Were the earth stationary they would blow due north and south from opposite sides of the equator. The motion of the earth causes them to be deflected and to become north-east and south-east winds.

The chief ocean currents are—

In the Atlantic, the South African, the Equatorial current, the Brazil, the Gulf Stream, the Polar, and the return Equatorials.

In the Pacific, the North and South Equatorial currents, the Black current of Japan, the return Equatorial currents, the Australian.

In the Indian, the Equatorial, the Mozambique, and the Agulhas.

The South African current becomes the Atlantic Equatorial which flows westward towards the coast of Brazil. Here it divides, part of it flowing past Brazil and becoming the South Equatorial, the Northern branch passing through the Carribean sea into the Gulf of Mexico, whence it issues by the Strait of Florida as the Gulf Stream. This flows in a north-east direction till it is dispersed, some part flowing past Morocco and the west coast of Africa and enclosing the Sargasso Sea.

FOURTH YEAR.

(Answer three questions only.)

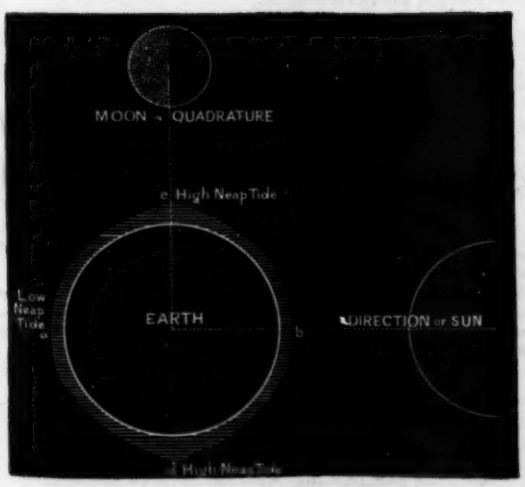
1. Draw a map of the United States, with latitude and longitude, marking the chief mountain ranges and rivers.

2. How is the tidal wave caused? Show the positions of the sun, moon, and earth at spring and neap tides, and compare the sizes of the three bodies.

3. Explain, with diagrams, why the days are (1) longer and (2) warmer in Summer than they are in Winter, and (3) why the heat of Summer is rather greater in the Southern Hemisphere than in the Northern.

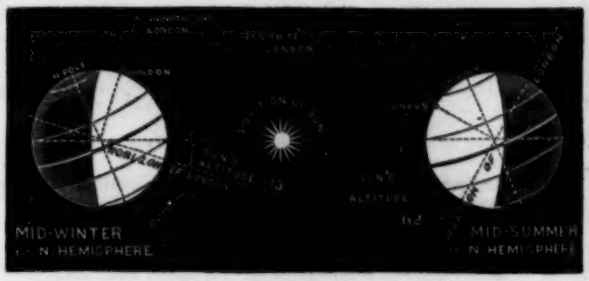
4. Write as full an account as you can of one of the great oceans.

(2) Every body attracts every other body in nature according to size and distance. The earth is thus attracted by the sun and moon, but the waters of the earth, being free to move, are more attracted than the whole body of the earth, which must move as a mass, and are thus heaped up as it were on the side nearest to these heavenly bodies. Were the moon and earth stationary this heaping up would always be in one place, but as the earth moves round on its axis once in 24 hours, it occurs always on the side nearest the moon, the earth thus leaving the water behind it, or, in other words, the water is formed into a tidal wave.



The sun is 883,000 miles in diameter, the earth is 8,000, and the moon is 2,160 miles.

(3) The axis of the earth is inclined to the plain of its orbit. When therefore the part of the earth on which we live is turned towards the sun as in diagram A, then the rays of the sun will be more vertical and the days will be warmer; the days will also be longer because more than half of the circle or parallel on which we are situated is within the half of the world on which the sun shines at once.



Water retains its heat longer than land. The Southern Hemisphere is largely composed of water. The loss by radiation, therefore, during the night, in the Southern Hemisphere, is less than the loss in the Northern Hemisphere, which is much more largely covered by land. Hence the summer temperature of the Southern Hemisphere is higher than that of the Northern Hemisphere.

(4) The Atlantic Ocean stretches from the Arctic to the Antarctic Circle, a distance of 9,000 miles, and is about 4,000 miles wide in its broadest part. It is nearly closed to the Arctic Ocean, but has a broad expanse when it reaches the great open Southern Ocean. Its shape is like a cleft, the parts on the east seeming as if they would fit into the depressions on the west. Europe and Africa form its eastern and North and South America its western boundary. The chief seas connected with it are the Baltic, North, and Mediterranean in Europe, the Gulf of Guinea in Africa, and the Caribbean Sea, Gulf of Mexico, and Gulf of St. Lawrence in America. The British Islands, Azores, Cape Verd, and Madeiras are found near the eastern continents, and the West Indies, Bermudas, and Newfoundland near America. Stretching for hundreds of miles along the bed of the North Atlantic is a large plateau crossed by a ridge. On this the cables joining the continents are laid. The ocean receives the waters of the longest rivers in the world, the Amazon, Orinoco, and La Plata in South America, the Mississippi and St. Lawrence in North America, nearly all the rivers of Europe and the Niger and Congo of Africa. It is the great highway of commerce, the chief civilized nations of the world lining its shores. Its storms are plentiful but not so violent as those of the Western Pacific. Its currents of winds are made serviceable to commerce. Its area is about 25,000,000 square miles.

Needlework.

FIRST YEAR.

(One hour allowed for this exercise.)

Set in a calico patch, two inches square. Show two methods of sewing on tapes.

SECOND YEAR.

Fix and work not less than four inches of the following stitches:—Sew and fell, hemming, and stitching. Marks will be given for general finish.

THIRD YEAR.

Make a wrist-band with rounded corners, suitable for a boy's shirt sleeve. Stitch at least half of it. Make a button-hole, and sew on a button. Marks will be given for general finish.

FOURTH YEAR.

On each side of a piece of calico 9 inches square, fix a hem ¾ inch wide, and work not less than four inches of hemming. Make a button hole, with two braced ends. Darn a hole (common method) on stocking material. Marks will be given for general finish.

Grammar.

Males and Females.

FIRST YEAR.

(Answer questions 1 and 2 and one other question.)

1. 'Then closing fast, with *furious* gripe
He clasped the champion round,
And with a strong and sudden twist,
He laid him on the ground.

'They rolled and grappled on the ground
And there they struggled long:
Skilful and *active* was the knight;
The savage he was strong.

'But *brutal* force and savage *strength*
To art and skill must yield;
Sir Valentine at length prevailed,
And won the well-fought field.'

Analyse the first two and the ninth and tenth lines in the above passage.

2. Parse each word in the last two lines.

3. Explain the terminations of each of the words *in italics*, and give three examples of words similarly formed.

4. Make six sentences containing relative pronouns, in two of which the relative shall be in the nominative case; in two, the possessive; and in two the objective case.

(1)

SENTENCE	KIND OF SENTENCE	SUBJECT	PREDICATE	OBJECT	EXTENSION OF PRED.
Then closing fast, with furious gripe he clasped the champion round	Princ. Sent.	He, then closing fast	clasped	the champion	round
But brutal force and savage strength to art and skill must yield	Princ. Sent.	[But] brutal force and savage strength	must yield	to art and skill (ind.)	

(2)

Sir—noun, proper, masc., sing.
Valentine—noun, proper, masc., sing. } nom. to prevailed.
at—prep. showing rel. between *length* and *prevailed*.
length—noun, neut., sing., 3rd, obj., gov. by *at*.
prevailed—verb, reg., int., act., ind., past., 3rd, sing., agreeing with its nom. *Sir Valentine*.
and—conj., cop., joining the sentences 'Sir Valentine prevailed' and 'He won.'
won—verb, irreg., trans., act., ind., past, 3rd, sing., agreeing with its nom. 'he' und.
the—disting. adj., pointing out *field*.
well-fought—adj. of quality, qual. *field*.
field—noun, com., neut., sing., governed by *won*.

(3)

WORD.	AFFIX.	MEANING.	OTHER EXAMPLES.
Furious	-ous	fulness	curious, famous, glorious
skilful	-ful	full of	playful, sinful, needful
active	-ive	inclined to	pensive, restive, massive
brutal	-al	having the qualities of	animal, legal, regal
strength	-th	denotes an abstract idea	breadth, length, width

(4)

Nom.—He told me the name of the teacher *who* had instructed him.
Who steals my purse steals trash.
Poss.—*Whose* house is that?
I asked her *whose* child she was.
Obj.—I know not of *whom* you speak.
I shall give it to *whomsoever* I please.

SECOND YEAR.

(Answer Questions 1 and 2 and one other Question.)

'Hard by, a cottage chimney *smokes*,
From *betwixt* two aged oaks,
Where Corydon and Thyrsis *met*,
Are at their savoury dinner *set*
Of herbs, and *other* country messes,
Which the neat handed Phyllis *dresses:*
And then in haste her bower she leaves,
With Thestylis to bind the sheaves;
Or if the earlier season *lead*
To the *tanned* haycock in the mead.'—*Milton.*

1. Turn the above passage into simple prose, adhering as closely as you can to the original.

2. Analyse the first six lines, and parse the words in *italics*.

3. Point out the force of the Latin prefixes in the following words:—*contradict, dissimilar, oppose, affix, suspend*, and of the Latin affixes in *possible, regal, armament, exultation, famous*, and give in each case another example of a word similarly formed.

4. Make four sentences in which the predicate is extended by phrases relating to time, place, manner, and cause or reason, respectively.

(1) From between two aged oaks at a little distance may be seen the smoke issuing from a cottage chimney. Here Corydon and Thyrsis having met are sitting at a dinner of herbs, and other country messes which have been prepared by the neat handed Phyllis. This duty done she quickly left her house to join Thestylis in binding sheaves in the cornfields in the autumn, or in making hay in the summer.

(2)

smokes—verb, reg., intr., act., ind., pres., 3rd, sing., agreeing with its nom. *chimney*.
betwixt—prep., showing rel. between *oaks* and *place* understood.
met—past part. of verb *to meet*, forming with *having* understood the perfect participle active, referring to Corydon and Thyrsis.
set—past part. of *to set*, referring to Corydon and Thyrsis, forming with *are* the pres. ind. passive of to set.
other—indef. adj. pro., qualifying *messes*.
which—pro., rel., neut., plur., 3rd, obj., gov. by *dresses*, and agreeing with its antecedents *herbs* and *messes*.
dresses—verb, reg., trans., act., ind., 3rd, sing., agreeing with its nom. *Phyllis*.
lead—verb, irreg. intrans., act., cond., pres., 3rd, sing., agreeing with *season*.
tanned—adj. of quality, qual. *haycock*.

SENTENCE	KIND OF SENTENCE	SUBJECT	PREDICATE	OBJECT	EXTENSION OF PRED.
(*a*) Hard by a cottage chimney smokes from betwixt two aged oaks	Princ. Sent.	a cottage chimney	smokes		hard by from betwixt two aged oaks (place)
(*b*) Where Corydon and Thyrsis met are at their dinner set of herbs and other country messes	adj. sent. to (*a*)	[where] Corydon and Thyrsis [having] met	are set		at their dinner of herbs and other country messes (place)
(*c*) Which the neat handed Phyllis dresses	adj. sent. to (*b*)	the neat handed Phyllis	dresses	which	

(3.)

WORD	PREFIX OR AFFIX	FORCE	OTHER EXAMPLES
Contradict	contra-	against	contravene
dissimilar	dis-	apart, negation	dissuade
oppose	op-	in the way of	oppress
affix	af-	to	affect
suspend	sus-	under	sustain
possible	-ible	possibility of something being done	edible
regal	-al	possessing the qualities of	royal
armament	-ment	means or instrument	ornament
exultation	-tion	denotes action	lamentation
famous	-ous	fulness	curious

(4.) (1.) He followed the man closely *in the early morning*.
(2.) John carried his brother *over the river*.
(3.) Henry did his lesson *in a slovenly way*.
(4.) I answered him so *for a very good reason*.

THIRD YEAR.

(*Answer questions* 1 *and* 2 *and one other question.*)

1. Re-write in prose, the substance of the following lines :—

My eye *descending* from the hill *surveys*,
Where Thames among the wanton valleys *strays*;
Hasting to pay his tribute to the sea,
Like mortal life to meet eternity . . . .
No unexpected inundations spoil
The mower's hopes, nor mock the ploughman's toil,
But God-like his unwearied bounty flows;
First *loves to do*, then loves the good he does.
Oh, *could I flow like thee*, and make thy stream,
My great example, as it is my theme!
Though deep, yet clear, though gentle yet not dull,
Strong without rage, without o'erflowing, full.

2. Parse the words printed in italics, and analyse lines 5 to 8.

3. As a general rule, it will be found that words relating to common natural objects and to home life are of English origin. Explain this statement, and illustrate it by examples.

4. Which of the following words do you recognise by its form as of Latin, and which of them as of English, origin? Give other like examples. *Fortitude, strength, unhappy, imperfect, purify, harden, princess, goodness, veracity, kingdom, manhood, expel, conversation.*

1. As I look down from the hill I see the Thames winding along through the verdant valleys, its waters finding their way to the sea where they are for ever lost just as the years of time are merged into eternity.

The river does not overflow its banks, and thus spoil the hay, or render worthless the labour of the ploughman; but in its passage acts like the Great Creator, pouring its riches on all around, first making the valleys fruitful and then seeming to rejoice at the good it has done.

Oh that I could take the manner of thy flow as my example just as it is now the burden of my song. My life would then be serious, yet transparent; calm and peaceful, yet joyous and happy. My influence would be great, although not gained by anger or force, and my life would be full of goodness and happiness without alloy.

(2)

Descending—pres. part. of *to descend*, referring to *eye*.
surveys—verb, reg., trans. (obj. *place* und.) ind., pres., sing., 3rd, agreeing with its nom. *eye*.
strays—verb, reg., intrans., act., ind., pres., 3rd sing., agreeing with its nom. *Thames*.
no—indef. adj. of number, qualifying *inundations*.
loves—verb, reg., trans., act., ind., pres., sing., 3rd. agreeing with its nom. *he* und.
to do—verb, reg. trans., inf., used as an abstract noun, neut., sing., 3rd, gov. by *loves*.
could—verb, irreg., intrans., ind., past., aux. to *flow*.
I—pro., pers., com., sing., 1st, nom. to *could flow*.
flow—verb, reg., intrans., inf., pres., gov. by *could*.
could flow—verb, reg., intrans., act., conditional mood, with the potential form, past tense, sing., 1st, agreeing with its nom. *I*.
like—adj. governing *thee*.
thee—pers. pro., neut., sing., 2nd, obj. case, gov. by *like*.

3. In a nation which is only partially civilized, the vocabulary is limited, the words in most frequent use being the names of things by which the people are surrounded, and which are connected with every-day life. The early English had little or no acquaintance with arts, sciences, literature, &c., the principal terms of which belong to the Latin and Greek languages, but everyone knew the names of common objects, things in the house, and animals, these having been brought from their home in Europe. These names have naturally descended to their successors, and the statement contained in the question is the truth. The following words illustrate the fact:—*Common natural objects*:—Ox, horse, deer, fish, hair, apple, leek, daisy, stone, clay, gold, snow, rain, hail. *Home life*:—House, bed, cot, bucket, farm, wagon, smith, cloth, board, wheat.

LATIN.	OTHER WORDS.
fortitude.	similitude, beatitude.
imperfect.	impossible, implacable.
purify.	magnify, glorify.
princess.	duchess, mistress.
veracity.	sagacity, loquacity.
expel.	compel, repel.
conversation.	consummation, conflagration.

ENGLISH.	OTHER WORDS.
strength.	length, breadth.
unhappy.	unlucky, uncanny.
harden.	soften, glisten.
goodness.	hardness, blackness.
kingdom.	wisdom, freedom.
manhood.	girlhood, boyhood.

FOURTH YEAR.

(Answer questions 1 and 2, and one other question.)

1. Give in your own words the meaning of this passage:

Ah! who can tell how hard *it is* to climb
The steep *where* Fame's proud temple *shines afar*!
Ah! who can tell how many a thought sublime
Has felt the influence of malignant star,
And waged with Fortune an eternal *war*—
Checked by the scoff of Pride, by Envy's frown,
And Poverty's unconquerable bar—
In life's low vale remote *has pined* alone,
Then dropped into the grave, unpitied and unknown?

2. Take the words printed in italics, parse them, and show as fully as you can what is the relation of each to the rest of the sentence.

3. Give examples illustrative of each of the following terms: Nominative absolute; Noun sentence; Inflection; Strong verb; Intransitive; Passive; Subordinate.

4. Say what you know about the Lake Poets, explaining why the name was applied to them, and naming their principal works.

5. Explain by reference to their origin the meanings of these words: capture, version, scribble, liberate, bankrupt, mansion.

1. It is almost impossible to tell the difficulties which beset the path of those who would become famous. Many noble thoughts and aspirations have seemed to be fighting continually to, and yet unsuccessfully for, recognition and success. Sometimes they have been laughed to silence by pride, or frowned upon by envy. Poverty often has prevented their realization, so that the spirit which formed the thoughts has been unable to emerge from the obscurity in which it was born and eventually passes away utterly unappreciated with none to pity or mourn its decease.

(2)

Ah!—An interjection.
it—pro., pers., neut., sing., 3rd, nom. to *is*, and in apposition with 'to climb the steep.'
is—verb, irreg., intrans., act., ind., pres., 3rd pers., sing., agreeing with its nom. *it*.
where—advb., conj., joining the sents. 'It is hard' and 'Temple shines,' introducing adj. sent.
shines—verb, irreg., intrans., act., ind., pres., 3rd, sing., agreeing with its nom. *temple*.
afar—adv. of place, modifying *shines*.
war—com. noun, neut., sing., 3rd., obj., gov. by *waged*.
has—verb, irreg., trans., aux. to *pined*, indicating perfect tense.
pined—past part. of to pine, reg., intrans., referring to *thought*.
has pined—verb, reg., intrans., act., ind., perfect, 3rd, sing., agreeing with its nom. *thought*.

(3).

Nominative absolute: *Spring* returning, the swallows reappear. The *letter* being finished, he quietly folded up the paper.
Noun sentence: He asked him *where he lived*. I told him *he was a naughty boy*.
Inflection: For gender—tiger, tigress. For number—church, churches. For case—boy, boy's. For tense—love, loved. For mood—am, be.
Strong verb: Sit, sat, sat; ride, rode, ridden; bear, bore, borne.
Intransitive: Birds *fly*. Man *weeps*.
Passive: Love, *am loved*; fight, *was fought*.
Subordinate: I asked him *what he wanted*. He bought a horse *which was lame*.

(4).

The 'Lake Poets' were William Wordsworth, Samuel Taylor Coleridge, and Robert Southey. They were so called because two of them lived not far from each other in the Lake district of England, and their poetry was of the same character. Their poetry consisted largely of description of men and things of every-day life, its chief principle being that poetry was the real language of men of quick perception and ready sympathy, reduced to a metrical arrangement. Wordsworth wrote lyrical ballads 'The Excursion,' 'The White Doe of Rylstone,' and many smaller poems, as 'Ruth,' 'Laodamia,' 'Yarrow Unvisited and Revisited.' Coleridge wrote 'The Ancient Mariner,' and 'Christabel.' Southey wrote 'Joan of Arc,' 'Thalaba,' 'Madoc,' and 'Roderic.' He also wrote Lives of Nelson and Wesley, and several histories.

(5.)

Capture—Lat. capio, I take, -ure, affix, meaning the act of, the act of taking.
version—Lat. verto, I turn, -sion, state of, the act or state of turning.
scribble—Lat. scribo, I write, to write carelessly.
liberate—Lat. liber, free, -ate, to make, to set free.
bankrupt—a hybrid word. Bank A.S. a bench or seat. Lat. rumpo, I break; one whose business is broken up; one who cannot pay his debts.
mansion—Lat. maneo, I remain.

History.

Males and Females.

FIRST YEAR.

(Answer three questions only.)

1. State some of the results of the Roman occupation of Britain? What remains still exist?

2. How did Kent and Northumbria become Christian?

3. Describe briefly the rise and progress of Mercia or Wessex.

4. Say what you know of these persons:—Agricola, Bede, Dunstan, and Godwin. Write a short account of one of them.

(1) Large towns were built, the names of which have remained till the present time (Lincoln, Leicester, Lancaster, Winchester, Doncaster, Chester, Manchester). These were connected by good roads some of which are still in existence. Agriculture was improved so much that Britain became a corn-exporting country, the mines of tin, copper, and iron, were worked, the people became more civilized and less warlike. Parts of many of their streets remain, the wall between the Tyne and Solway is still in existence for many miles of its length; some of their city walls, many of their altars, tombstones, and inscriptions on public buildings, are still to be found in many places especially in the north of England.

(2.) The heathen English learned nothing from the Christians in Britain. Their conversion was first attempted by missionaries from Rome. Gregory became interested in the country through seeing some English children in the market place of the city, who were being sold as slaves. When he became pope he sent Augustine with some forty priests and monks to this country. The King of Kent had married a Frankish princess from Gaul, who was a Christian. She was allowed the free exercise of her religion by her heathen husband. By her he was persuaded to receive and hear Augustine. Ere long Ethelbert was converted, the monks were located in Canterbury, of which Augustine became the first Archbishop, and in the course of twenty years he ordained two bishops, Rochester and London, and the whole of Kent was thus covered with Christian places of worship and became Christian.

Ethelred's daughter married Edwin of Northumbria, and he was converted to Christianity by Paulinus, a bishop she took to the north. His Witan embraced Christianity also, but when he fell in battle, fighting against Penda, the heathen King of Mercia, Paulinus fled to Kent, and for a time it seemed as if the north would relapse into heathenism. Oswald, however, became king. He defeated his enemies, brought monks from Iona and Melrose who taught and preached in the villages throughout his dominion, which gradually became Christian, although, in many places, their religion was often mixed with heathenism. After the synod of Whitby in 664, the whole of the country came under the spiritual rule of the Archbishop of Canterbury.

(3) Up to the close of the seventh century, Northumbria had been the leading kingdom in England, but its power then began to decline, and Wessex in the south and Mercia in the centre began to shine for supremacy. Wessex was ruled by the descendants of Cerdic its founder, and the kingdom increased by constant encroachments on the lands of the Welsh. Ine, the king in 688, added Somerset to his dominion. A number of his laws have come down to us. From 700 to 800, Wessex gained territory on all sides, and when Egbert became king in 802, he brought nearly the whole of England an

Wales more or less under his rule. He was king of the Saxons and Jutes, and lord of the East Angles, Mercians, and Northumbrians, the kings of these provinces submitting to be his vassals. Although not the only king in Britain, he was able to style himself 'King of the English.'

(4) *Agricola* was the governor of Roman Britain from A.D. 78 to 84. He conquered the northern part of the country as far as the Firths of Forth and Clyde, building a chain of forts between them to protect the new frontier, in addition to the line between the Tyne and Solway. He was never able to wholly subdue the northern Caledonians, although he defeated them at the foot of the Grampians. He was the first to sail round the island, his fleet taking possession of the Orkneys. His rule was wise and beneficent; he checked the extortions of the Roman officials, and encouraged the British to acquire all the arts and manners of civilized Rome. Under him the chieftains' sons learned Latin, and wore the distinctive dress of the Romans. The country was perhaps more prosperous than during any equal period of the Roman occupation.

Bede, a monk who lived at Jarrow-on-Tyne, who translated parts of the scripture, and wrote a history of Britain. He died 735.

Dunstan, Abbot of Glastonbury, and afterwards Archbishop of Canterbury, the most powerful of the advisers of the kings from 946 to 988.

Godwin, a Kentish earl, who exercised great influence during the reign of Edward the Confessor, and whose son, Harold, became the king till defeated by William the Conqueror.

SECOND YEAR.

1. What was the origin of the Hundred Years' War? Give the dates of the chief battles.

2. Describe the career of Simon de Montfort.

3. Narrate the leading political events connected with the Reformation in the reign of Henry VIII.

4. 'The annals of Elizabeth are adorned with some of the greatest names of English literature.' Explain and illustrate this statement.

(1) On the death of Charles IV. of France in 1328, Edward III. king of England laid claim to the throne by right of his mother. The French disputed the claim saying that Edward was excluded by the Salic Law. Nothing came of the claim till Philip, the actual king, encroached on Edward's domains in Aquitaine, when the claim was again made. The result was that the 'Hundred Years' War' was commenced. It was so called not because war actually continued during that time but because there was no lasting peace. The chief battles were—

Sluys, 1340.
Crecy, 1346.
Siege of Calais, 1347.
Neville's Cross (in England, 1346).
Battle in English Channel, 1350.
Poictiers, 1356.
Siege of Harfleur, 1415.
Battle of Agincourt, 1415.
Siege of Orleans, 1428.
Patay, 1429.
Castellon, 1453.

(2) Henry the Third's conduct led to the passing by the Mad Parliament of the Provisions of Oxford. His favourites were dismissed, but the Barons quarrelled, and Henry tried to regain his authority. This led to the Barons' War, the malcontents being headed by Simon de Montfort a Frenchman who had married the King's sister, and who became a thorough Englishman under the title of Earl of Leicester. He was a brave and good man, skilful in war and statecraft. He depended for his power upon the clergy, the universities, and the goodwill of the people. The Battle of Lewes, 1264, ended in the victory of Simon, and for a time the war was put an end to by the Mise of Lewes, by which the earl became the practical ruler of the country. He called in Henry name a parliament in which were representatives from the counties and the boroughs of the kingdom. His power did not last long, for some of the Barons turned against him owing to the ill conduct of his sons. Prince Edward escaped from his confinement, and defeated Simon's son at Kenilworth, while the Earl himself was defeated and killed at the battle of Evesham in 1265.

(3) King Henry VIII. professed to have scruples respecting the validity of his marriage with Katharine of Aragon. He sought a divorce which was opposed by the Pope and this led to the separation of the English Church from Rome.

Henry married Anne Boleyn in spite of the Pope's prohibition. Wolsey was disgraced on the ground of transgressing the Statute of Premunire. Then followed a statute in 'Restraint of Appeals,' quickly succeeded by the stoppage of payments to Rome, and the declaration that Henry was the Supreme Head of the Church in England. Sir Thomas More was now beheaded because he would not swear to maintain the *Act concerning the King's succession*, all these events being political and widening the breach with Rome. Cromwell, the Earl of Essex, succeeded More in the Chancellorship, and under his administration the monastic foundations were destroyed, an act which led to the Pilgrimage of Grace. When this had been put down the abbots gave up their possessions and the Pope issued a Bull excommunicating and deposing Henry, using Cardinal Pole to stir up foreign powers against him. The publication of Articles of Religion and the Statute of Six Articles were other succeeding political events.

(4) The value of any literature may be judged partly by the favour in which it is received at the time it is published but more by the way in which it is viewed by posterity. Judged by the latter standard the annals or records of Elizabeth's reign contain the names of some of the greatest and best of English writers. In proof of the above statement the following names with their works may be mentioned:—Roger Ascham who wrote 'The Schoolmaster,' Sir Philip Sydney 'Arcadia,' Bishop Hooker 'Ecclesiastical Polity,' Bishop Jewel 'Apology for the Church of England,' John Foxe 'The Book of Martyrs,' Edmund Spenser 'The Faerie Queen,' Ben Jonson, Marlowe, and Shakespeare, who wrote plays; and Lord Bacon who wrote Essays. These works are still extensively read, and many of them are the classics of English literature.

THIRD YEAR.

1. Give a short life of any great statesman or soldier in the former half of the 17th century.

2. How did James II. show his attachment to the Church of Rome? Mention some statesmen or other persons of eminence who approved, and others who opposed his policy.

3. What were the chief public transactions in which the younger Pitt was engaged, and what share did he take in them?

4. Recount in order the chief military exploits of the Duke of Wellington.

(1) The Earl of Strafford was formerly known as Sir Thomas Wentworth. He was a wealthy Yorkshire landowner, and began his political career as a patriot. He was a great friend of John Hampden's, and one of the most powerful of the opponents of Charles. He was induced, however, to forsake his party, and, together with Archbishop Laud, became the chief instrument of furthering the policy of the king, which was, to become absolute. After being raised to the peerage, he was made president of the Council of the North, obtaining unlimited powers. Here he began his policy of 'Thorough,' persecuting the Irish Puritans and Presbyterians with great rigour. The Scots having been driven to rebellion by the attempt of Charles to enforce upon them the English Church, Strafford came over to assist in defeating the Covenanters. Strafford advised the calling of a parliament, which, however, lasted only a few days. In the same year, however, 1638, he was compelled to call another, now known as 'The Long Parliament.' This body immediately impeached Strafford, who was ultimately convicted, under a Bill of Attainder, and beheaded on Tower Hill in 1841.

(2) He went to mass in royal state immediately on his accession to the throne. He prorogued parliament because they would not sanction his keeping Roman Catholic officers in the army. He dismissed judges who would not lend themselves to his purposes. He made Roman Catholics privy councillors, and allowed them to hold Protestant benefices. He appointed a Roman Catholic nobleman Lord Lieutenant of Ireland, and all the offices in that country were filled by men of his own religion. Magdalen College became a Roman Catholic seminary, after a member of that communion had been made Dean of Christchurch. He issued a Declaration of Indulgence, and tried to relax the municipal laws against his co-religionists. He prosecuted the seven bishops for refusing to promulgate a second Declaration of Indulgence. Some of the chief opponents of James's policy were the Earls of Shrewsbury, Devonshire, and Danby, the Bishop of London, Edward Russell, Henry Sydney, and the seven bishops. Judge Jeffreys, Edward Petre, and the Earl of Tyrconnel were among James's friends and advisers.

(3) Immediately on Pitt's entry into the House of Commons, he made propositions for parliamentary reform. On becoming prime minister he introduced his India Bill, which made the Governor-General of India a member of the English Cabinet, and thus brought him under the control of parliament. He became a financial reformer, impeached Warren Hastings, and started the opposition to the slave trade. He endeavoured to maintain peace during the French Revolution, but was forced by the public feeling of England to enter into a war with France after the execution of Louis XVI. He quelled the Irish rebellion in 1798, and then promoted the Union of Great Britain and Ireland. The policy of Pitt throughout the whole of his career as a minister was to promote reform, and to foster trade. To this end he bent all his efforts for the maintenance of peace during the whole of the later part of his life.

(4) Wellington's chief exploits were—Distinguished himself at Seringapatam, 1799. Battles of Assaye and Argaum, 1803. Kjoge near Copenhagen, 1807. Vimeira, 1808. Talavera, 1809. Stormed Ciudad Rodrigo in 1812, and Badajos, 1812. Battle of Salamanca in 1812. Stormed San Sebastian, 1813, andgained battle of Vittoria, 1813, and Toulouse, 1814. Quatre Bras and Waterloo were added to the list in 1815.

FOURTH YEAR.

1. What Acts were passed in the reign of Charles II. against Roman Catholics and other Nonconformists?

2. Give instances of political reform and social progress during the reign of Queen Victoria.

3. Describe concisely the administration of Warren Hastings.

4. Explain the circumstances attending the loss of our American Colonies. Say also what addition was made to our Colonial possessions during the Eighteenth Century.

(1) The Corporation Act, 1661.
The Act of Uniformity, 1662.
The Conventicle Act, 1663.
The Five Mile Act, 1663.
The Test Act, 1673.
An Act excluding Roman Catholics from the King's presence and both Houses of Parliament, 1678.

(2) The following are examples of political reform:—
The Reform Bills of 1867 and 1884; Redistribution of Seats, 1885; Ballot Act, 1872; Disestablishment of Irish Church, 1868; Irish Land Acts, 1870, 1881, and 1887.

Signs of social progress may be seen in the spread of education, which is now universal; the extension of cheap literature, the best of books now being within the means of all, or available in numerous free libraries; the establishment of cheap postage; the rapid means of communication by rail and steam, or by telegraph or telephone; the spread of temperance; the decrease of poverty and crime, the increase of the wealth of every class, as shown in the numerous friendly and co-operative societies and savings' banks; the opening of public parks in many towns; the shortening of the hours of labour, the great care taken of the sick and poor in hospitals, infirmaries, and many other charitable institutions; the cheapening of food, and improvement in the homes of the poorer classes; the entire disuse of many of the more brutal forms of sport; the increased appreciation of music and the other fine arts, and the holding of many international and provincial exhibitions of the arts and industries of the country.

(3) Warren Hastings succeeded to the Governor Generalship of India and determined to carry on the work of his predecessor Clive, and make the whole of India subject to Britain. He would do this by fair means when possible, by foul means if necessary. To this end he assisted Surajah Dowlah of Oude against the Rohillas who had done him no wrong, but could not pay so high a price for his favour as their enemy. The Rohillas were defeated and massacred. He was losing his influence in his own council, to terrify whom he had Mindkomar, a Hindu, put to death. By bribery he secured the neutrality of many chiefs and then defeated Hyder Ali in the Mysore. The East India Company always wanted money from him and he demanded more from the Rajah of Benares. When he could not get it he annexed the district. The Nawab of Oude who had to pay tribute assisted him in obtaining by foul means the money of the Begums of Oude. India was thus becoming the property of England. But in 1783 Pitt's India Bill was passed, Hastings was recalled and impeached. Although acquitted no successor has dared to practise the same injustice and tyranny.

(4) The English ministry under Grenville attempted in 1765 to impose taxes on the American colonies by means of the Stamp Act. The colonists resisted and the Act was repealed in 1766. The whole of the import duties previously imposed were also withdrawn with the exception of that on tea, and as the colonists would not use the tea at Boston some ships were boarded and the tea tossed into the harbour. Troops were sent out, and the whole colony was roused. Delegates met at Philadelphia, and, while firm, desired to maintain peace. Pitt and Franklin devised a scheme for pacification, but it was rejected. Then the colonies issued the Declaration of Independence, 1776. War was declared, varying fortune accompanied the combatants, but the surrender of Burgoyne and Lord Cornwallis completed the overthrow of the English, and the independence of the United States was recognised.

The additions to our colonial possessions in the eighteenth century were:—In the reign of Anne, Nova Scotia, Hudson's Bay and Newfoundland, the island of Minorca and St. Christopher; Canada in the reign of George II.; the greater part of India in the reign of George II. and III.

School Management.

Males and Females.

SECOND YEAR.

(*Answer two questions only.*)

1. What is the best way of arranging a class for a reading lesson so as to secure (*a*) distinctness of utterance, and (*b*) readiness on the part of the scholars to observe and correct mistakes?

2. In writing in copy-books, there is a great tendency to repeat the same mistake down a whole page. What is the best method of correcting this?

3. Give examples of questions in mental arithmetic suited to children of the third standard, which shall illustrate all the rules taught to children of that standard, and shall prepare them for the work of the fourth.

4. Show which of the manual exercises of little children in infants' schools are helpful in teaching the elements of arithmetic, and say how you propose to use them.

(1) If the class is small, the best way is to arrange them in a half circle, the teacher being at the centre. They can then see and hear the teacher plainly, and are in the best position for imitating him. They can also see and hear each other, and thus most readily detect mistakes. If the class is large it should be arranged, if possible, on a gallery. If that is unavailable, the children should sit close together in the desks, and if there are more than three rows the front rows should face the others, or hearing and ability to carry out No. 2 will be difficult.

(2) If head-line copy books are used the copy should be repeated a second or a third time down the page. If the copying is from the blackboard the blotting paper should cover the last line the child has written. Another plan is to have moveable head-lines, printed copies being used, which can be given out to each child and placed directly above the line to be written. When these are used, beginning to write the bottom line first and proceeding up the page may sometimes be tried with advantage. Each of these plans has its advantages, and each is the best according to the kind of copy book in use.

(3) Add 17, 13, 12, 9, 5, and take away 14 and 10. From 54 take 19. How many shillings in the remainder if called pence? Divide 54 apples among 6 boys. Break 769 into hundreds, tens, and units. How many farthings in 16 pence? In 15½d.? In 1s. 2d.? Six quarts of milk at 5½d. a quart? ½ pound of butter at 1s. 4d. per pound? 10 days' wages at 9d. a day? Take 5½d. from 2s. 6d. Add 5½d., 8½d., and 1s. 2d. How many ounces in ¼ lb.? ½ lb.? ¾ lb.? A boy walked ¼ mile, how much farther would he have to go to finish a mile? How much would each of 4 boys get out of 2s. 6d.? Which costs most, 3 things at 1s. 6d. or 4 at 1s. 3d.? How many inches in a yard? In half a yard? A boy steps 2 ft. 4 in., how many inches is that? A dozen apples at 3 a penny?

(4) Moving hands backwards and forwards, beating time with one or both hands, putting hands to heads and other parts of the body, putting out fingers one after the other.

Counting as the motions proceed, adding one and one of each, two and one and so on. Counting two beats with the right hand and two with the left (2 + 2 are 4), &c. Hands held up, one taken down (one from two leaves one); fingers may be used in the same way (5 from 10 leaves 5).

(*The remainder of answers will appear in our next issue.*)

Recent Inspection Questions.

Arithmetic.

STANDARD I.

A.

1. Add 21, 309, 8, 55, 325. 718. Ans.
2. From 300 take 255. 45. Ans.
3. From 209 take 197. 12. Ans.

B.

1. Add 874, 906, 80, 517, and 698. 3,075. Ans.
2. From 583 take 274. 309. Ans.
3. From 706 take 97. 609. Ans.

(Dictation.) *A.*

Work, ducks, watch, water, happy, little, house, farmer, young, chair.

B.

Round, place, master, night, street, lantern, person, house, window, school.

STANDARD II.

A

1. From 16,003 take 8,056. 7,947. Ans.
2. Multiply 8,097 by 780. 6,315,660. Ans.
3. Divide 15,001 by 8. 1,875 + 1. Ans.

B.

1. From 15,020 take 8,079. 6,941. Ans.
2. Multiply 57,063 by 69. 3,937,347. Ans.
3. Divide 13,012 by 7. 1,858 + 6. Ans.

STANDARD III.

A.

1. Divide 298,908 by 146. $2,047\frac{46}{146}$. Ans.
2. Take £940 9s. 6¾d. from £8,001 0s. 8¾d. £7,060 11s. 2d. Ans.
3. If I bought 60 buns and 100 oranges at a penny each, what change should I receive out of a sovereign? 6s. 8d. Ans.
4. Add £53,709 17s. 11½d., £1,729 14s. 11¼d., £5,705 13s. 7½d., £905 11s. 8¾d., £57,909 19s. 6¼d. £119,960 17s. 9¼d. Ans.

B.

1. Divide 664,900 by 158. $4,208\frac{36}{158}$. Ans.
2. From £48,001 0s. 10½d. take £7,940 10s. 10¾d. £40,060 9s. 11¾d. Ans.
3. If I travel 104 miles at a penny a mile by train and 17 miles at 3 pence a mile by coach, how many pennies will the journey cost? 155. Ans.
4. £9 18s. 0¾d. + £8,605 17s. 11½d. + £148 6s. 9¾d. + £48,001 14s. 8¾d. + £6,914 18s. 3½d. + £9 16s. 8½d. £63,690 12s. 6¾d. Ans.

STANDARD IV.

A.

1. If 1 cwt. costs £7 18s. 8d. what will 1 lb. cost? 1s. 5d. Ans.
2. A pig weighs 229 lbs., what will it cost at 6½d. per lb.? £6 4s. 0½d. Ans.
3. If a dollar is worth 4s. 2½d., how many will equal 101 half crowns? 60. Ans.
4. Reduce 16 sq. pls. 3 ft. 3 in. to inches. 627,699 in. Ans.

B.

1. If a mason earns 11½d. per hour, working 5 days a week, 10 hours a day, and 6 hours on Saturday, how much will he earn in a week? £2 13s. 8d. Ans.
2. Divide £780,694 18s. 9¼d. by 89. £8,771 17s. $0\frac{3}{4}$d. $\frac{10}{89}$. Ans.
3. In 1 ton 20 cwt. 2 qrs., how many stones? 324 stones. Ans.
4. Multiply £69 17s. 6½d. by 89. £6,219 1s. 2½d. Ans.

STANDARD V.

A.

1. If 16 men build a house in 42 days, how many men are required to build it in 28 days? 24 men. Ans.
2. How much must be added to $\frac{3}{4}$ to make $\frac{8}{9} + \frac{2}{3}$. $\frac{29}{36}$ Ans.
3. A coal merchant purchases a truck of coal, 7 tons 15 cwts. 2 qrs., for £5 5s. 0d.; what profit does he make by selling it at 10½d. per cwt. £1 11s. 0¾d. Ans.
4. Make out the following bill:—

   23 tables at 15s. 6d. each.
   19 chairs at 5s. 6d. „
   30 stair-rods at 12s. 6d. per dozen.
   42 yards at 3s. 4d. per yard.
   84 lbs. at 1s. 2½d. per lb.

   (£17 16s. 6d. + £5 4s. 6d. + £1 11s. 3d. + £7 0s. 0d. + £5 1s. 6d.)

   £36 13s. 9d. Ans.

B.

1. Find by practice the cost of 555 articles at £4 2s. 9¾d. each. £2,298 0s. 11¼d. Ans.
2. If a grocer mixes 56 lbs. of tea at 2s. 6d. per lb. with 117 lbs. at 2s. per lb., what will he gain by selling the mixture at 2s. 4d. per lb.? £1 8s. Ans.
3. Find a man's earnings for 4 years 146 days at 30 guineas per annum (365 days = 1 year). £160 12s. Ans.
4. If a man pays 3s. 4d. in the £ on £440, what has he left? £366 13s. 4d. Ans.

STANDARD VI.

A.

1. Simplify

$$\frac{4\frac{1}{2} - 3\frac{2}{5}}{7\frac{1}{9} + 1\frac{1}{2}} \times \frac{5\frac{1}{2} + 7\frac{1}{4}}{9\frac{1}{16} - 3\frac{3}{8}}$$

$\frac{44}{323}$. Ans.

2. How long will 56 men be in doing a piece of work which 175 men can do in $24\frac{4}{5}$ days?

$77\frac{1}{2}$ days. Ans.

3. What sum will produce £371 5s. of interest for $5\frac{1}{2}$ years at $4\frac{1}{2}$ per cent. simple interest?

£1,500. Ans.

4. A man on a tour spends $\frac{1}{2}$ of his money and $\frac{1}{3}$ of the remainder. He then had £43 7s. 4d. left; how much had he at first? = £130 2s. Ans.

B.

1. Simplify

$$\frac{6\frac{1}{2} \text{ of } 1\frac{1}{13}}{9\frac{3}{5} \div 5\frac{1}{5}}$$

$3\frac{12}{37}$. Ans.

2. Bring 7·325 acres to ac. rds. and poles.

7 ac. 1 rd. 12 pls. Ans.

3. Interest on £13,096 17s. 6d. at 3 per cent. for $4\frac{1}{2}$ years. £1,650 4s. $1\frac{1}{2}$d. Ans.

4. A man spends $\frac{1}{16}$ of his money and then $\frac{1}{14}$ the remainder and has £26 6s. 6d. left. What had he at first?

£31 10s. Ans.

STANDARD VII.

A.

1. The population of a certain town in 1881 was 288,236; this was 15 per cent. higher than in 1871. Find population for 1871. 250,640. Ans.

2. How long will it take £1,250 to amount to £1,666 13s. 11d. at 4 per cent. simple interest?

$8\frac{1}{2}$ yrs. Ans.

3. If 1,500 men can live for six weeks on a ration, when allowed 18 ozs. per day, how long will it serve 2,000 at 12 oz. per day. $6\frac{3}{4}$ days. Ans.

4. Find the principal which will amount to £606 17s. 6d. in 5 yrs. at $3\frac{1}{2}$ per cent. per annum.

£516 10s. Ans.

B.

1. Find average price per yard—3 yds. @ 5s. $10\frac{1}{2}$d., 4 yds. @ 2s. $5\frac{1}{2}$d., 3 yds. @ 5s. 8d., 8 yds. @ 3s. 4d.

3s. $6\frac{5}{9}$d. Ans.

2. It costs £7 8s. 6d. to keep 9 persons 121 days, how much will it cost to keep 11 persons in the month of December? 1s. 6d. Ans.

3. I spent $\frac{2}{3}$ of my money at a grocer's and then $\frac{4}{5}$ of the remainder at a grocer's. I then had 5s. $4\frac{1}{2}$d. left. How much had I spent?

£3 7s. $2\frac{1}{4}$d. Ans.

4. A man bought a watch in Paris for £16 10s., and sold it in London for £22. Find his gain per cent., his expenses being £2.75.

$29\frac{3}{11}$. Ans.

Geography.

STANDARD I.

Inspector asked children what geography they had learnt during the year? (About maps and plans.) Drew on slate a clumsy circle and asked would this do for plan of anything? (Yes, round thing.) Would it do for school? Why not? Then he altered it to perfect square, point out error still; What shape is required? (Oblong.) Corrected plan: filled up by children commencing where they stood; doors, windows, &c., erased by children after details were completed. How would size be measured? point out scale on the map; the lines which show size of square or oblong taken on which map is drawn; difference between map and plan. Point out a river on map; do rivers run up? Why then like that (flowing north). Direction N.E., S.E., &c., asked. Course from west to north taken; direction asked. Point to larger body of water than sea. What are the names of some oceans?

STANDARD II.

An irregular figure was drawn on board. If you could sail round it what would you call the figure? Projecting part was called a cape. How must it be marked to represent a promontory? A river added: what shows how land slopes? In what direction? Point to highest part of land. What is its name? Figure now divided into irregular parts showing where different peoples are habitated; what name given to whole figure? (Continent.) And the various parts? (Countries); the water near the land? (Sea); the great body spreading over whole board? (Ocean). Narrow part of figure cut through and canal formed; asked for name of this new passage, difference between this passage of water and strait between mainland and small island now added? Map of England used. Point out right bank of Trent. Pointing to map. If Swale and Ure tumbled down mountains what would this part of river be called? (still pointing to map.) But there are deep hollows here, tell the name given to such. The Yorkshire Wolds and Pennine Range were next pointed to. Why are not the hollow parts of land between shaded like the Wolds and Range? What kind of land is this intermediate part? Lakes of Cumberland taken; distinguish head and foot of lake. What mountain would you climb here to be the highest person in England?

STANDARD III.

Name the capital of England? In what county is it mainly situated? Name the other county on the opposite side of the river. What famous light at the mouth of river. Name a Kentish river running into its mouth. Name a famous military station on this river. Near to what dangerous sand-banks are you when at mouth of Thames?

Name a seaside watering place from whence you might see across the strait to France. Name a great naval station on the south coast. Another. What county on the opposite side of the river from Plymouth? Name minerals found in Cornwall? What name is given generally to their mountains? State the name given to the mountain heights in the north. Name a famous mountain in Derbyshire; the capital of Derbyshire; a river flowing through this

county; on what bank of Trent? Another on the right bank. (Soar.) Town on the banks of this river. At the mouth of the Trent what large opening have you? Another river flowing into this opening. Name an opening somewhat similar in the west of England. State any difference you may know between the two openings, respecting the tides. Name other openings on the west coast.

On the Chester side of the Mersey what cotton towns are there. What famous mineral is found here? Name some of these salt towns. Crossing Pennine Chain from Lancashire what county do we reach? North of this county what river have you? Cross this river and we enter what county?

STANDARD IV.

What name is given to the north part of North America? Is it thickly or thinly peopled? Why? In which part are there most people? How are they employed? What do you mean by lumbering? What sort of trees grow in Canada? Which province is noted for wheat? Which is its largest town? Name some of the provinces of Canada? Capital of Quebec? Some other large town? What sort of a winter is there in Canada? Name some amusements of the people? What sort of clothes do they wear in winter? Where do they get the furs? What fur animals are found? What is the name of the large river running into the Arctic Ocean? Whose name have you heard in connection with the Great Fish River? Who was Sir John Franklin? What did he try to do? Did he succeed? Which way did he sail? What is this range of mountains called? How has it lately been crossed? What advantage will this railway be? What province does it pass through on the other side of the Rocky Mountains? What is the capital of British Columbia? On what river is New Westminster? Name a large island near the mouth of the Frazer River. What ocean washes America on the West? On the East? Name some of the lakes of Canada? What river carries away the water of some of the largest lakes?

STANDARDS V., VI., VII. (taking STANDARD V.)

Name the islands in the Mediterranean Sea. Which of these belong to Italy? to France? to England? Name a mountain in Sicily. Who was born at Corsica? What country did he rule over? What use are Gibraltar and Malta to England? Name the largest river of Spain. What is the capital of Spain? What is the capital of Portugal? What do we get from Spain? Name two ports in the east of Spain? Name a sea between Italy and Austria? Name the islands on the east and west of Greece? What gulf cuts Greece nearly into two parts? What is the isthmus called? What is the capital of Greece? On what gulf is it? Name a mountain in Greece. What is the capital of Turkey? What is the Bosphorus? What two seas does it join together? Name some rivers flowing into the Black Sea. What sea does the Strait of Yenikale join together? What sea does the Don flow into? Name a German river flowing into the Black Sea. What mountains does it rise in? What countries does it flow through? Name the States in the north of Turkey, and also some towns in them. Name two ports in Austria. What sea do they stand on? What State is Belgrade in? What is the western part of Austria called? What European country has no sea coast? Name some lakes of Switzerland. What do tourists go to see in Switzerland? What is Geneva noted for? What two rivers rise in the same mountain in Switzerland? Name the States of Germany. Name the chief rivers of Germany. What are the capitals of Saxony? Bavaria? Baden? and Prussia?

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Publications Reviewed.

PRIZE BOOKS.

Messrs. Thomas Nelson & Son's Publications.

First Notice.

This parcel of prettily bound volumes is not one of tales and fictions, but none the less acceptable, we hope, to the fortunate young people who receive them as presents or prizes from their parents or schoolmasters.

(1) Life of Queen Victoria.

We feel sure that few prize books given and received during the present season will be read more earnestly, or with more pleasure, than this prettily written sketch of our much loved Queen.

The book is called one for young people—and for such it is admirably suited.

There are some pictures in colours of the Queen and her homes, which are beyond the average of such illustrations.

The book evidently left the writer's hands before the celebration of the jubilee, which is only referred to an l described as something coming; this we think is a pity, as such a volume, if only just published, might have easily contained an account of this remarkable event, and especially perhaps of the part the London children took in it.

(2) The Emperor of Germany, William I.

By Athol Mayhew.

The close connection which exists between our own Royal Family and that of Prussia, makes the members of the latter objects of great interest to us all, old and young.

This little volume was originally published in the *Illustrated London News*, and the pictures contained in the book are reductions of those produced in the paper. We are bound to say these have suffered considerably in the process, as some of them are very indistinct, beautiful as they were, as originally drawn.

We notice that the Author gives his readers credit for a knowledge of French, as the first sentence of Napoleon's letter, on the surrender of Sedan, is printed in the language in which it was written, without any translation being appended either in the text or as a note.

The account of the battle of Sedan is most graphically given, but not being written for children, some of them, we fear, will rather tire of the names and numbers.

(3) Great Waterfalls, Cataracts, and Geysers.

By John Gibson.

The illustrations of this volume are an important element in its constitution, and are decidedly well done.

We have here, fully and ably described, all the better known falls, beginning with the mighty Niagara, and concluding with the Cascade of Gavarnie, the highest in Europe.

After this we have the wonders of America's National Park in the Yellowstone region beautifully described, as well as the great geysers in Iceland and New Zealand.

Mr. Gibson commences the last paragraph of his well-written and instructive introduction with these words 'Magnificent and even terrible as is the fall of an immense body of water over a precipice, it is probably excelled in beauty by the rise of water into the air from a geyser:' it is as well then that boys and girls should know more of these.

Boys will read with a thrill the account of Professor Tyndall's walk beneath the very falls of Niagara, where he saw 'the green gleam of the mighty curve sweeping over the upper ledge, and the fitful plunge of the water as the spray between us and it alternately gathered and disappeared.'

This volume is particularly suitable for a boy with a taste for travel and the beauties of nature.

(4) Notable Workers in Humble Life. By Rev. E. N. Hoare.

We have here eight sketches of as many individuals, viz., John Pounds, John Duncan, Robert Dick, Thomas Edward, John Ashworth, Thomas Cooper, Robert Flockhart and George Smith.

To take one example at random, that of Thomas Edward, the naturalist. His very difficulties, as a child, a lad, and a young man, are well shown to have had much to do with forming his habits of indomitable industry, without which very few, if any, in spite of such obstacles as people placed in Edward's circumstances are bound to meet with, rise to eminence.

The volume will be found a most fitting prize for an industrious boy who feeling that he has something in him, would fain rise above his fellows. He will learn here the necessity of constant self-denial, unflinching truthfulness, and perhaps above all unwearying energy.

As others in past time have risen, so now we hope and believe there are many gradually rising step by step to eminence and above all usefulness, and to such, this volume will be an encouragement and a help.

(5) Masters of the Situation. By William James Tilley, B.D.

This is a series of essays on such subjects as Promptness, Application, and Opportunity, the last having the same title as the author has prefixed to the volume.

Though the essays are well illustrated with facts and examples, we are bound to say they are somewhat hard reading, and by no means suitable for boys or girls under 16 or even 17 years of age.

The volume could be read and studied by anyone with immense advantage, but it is not by any means one that can be taken up lightly and simply for amusement. As a prize, a fitting recipient must be carefully sought for, or we fear it would soon be delegated to the shelves to collect dust.

(6) Woodside. By Caroline Hadley.

In our opening sentence with regard to this parcel of books, we ought to have mentioned this little work as an exception, it being, unlike the others, a tale; but at the same time it is a tale with a very decided moral. On the title page we find the addition to the above title 'Look, Listen and Learn.'

The style of the narrative is exceedingly homely, and evidently intended for very young children. The children described in the book are quite little, being only ten, nine, and seven years old respectively.

They are staying with their Grandparents, and the old lady teaches them to notice, in other words, to cultivate their perceptives, in which as a rule our English children are so far behind their American cousins.

The story will be found decidedly interesting and valuable, and might be read to those who can't read it for themselves.

Messrs. Gill and Sons' Publications.

We have here two large volumes most profusely illustrated, the one intended to be instructive and the other amusing.

(1) Picture Gallery of the Animal Kingdom.

We think it rather hard no author's name appears on the title-page of this attractive volume.

The different animal kingdoms are arranged in what we presume now would be called an inverse order; instead of working up from the lowest forms of life to the, higher it begins with man and passes down to the cœlenterata and protozoa.

Under the pictures we notice the common names as well as the more learned are given, so that a child that could read could teach itself a great deal from the volume.

The preface tells us the publishers and others think it worthy of a place on the drawing-room tables of our wealthier folk no less than on the bookshelves of our poorer folk, and we agree with them.

(2) Fairy Life and Laughter. By Isabel Lawford.

This exceedingly pretty volume is divided into six divisions, viz., Mushroom, Leaf, Dewdrop, Sea, Star, and Mine Fairies.

The authoress would fain teach her young readers valuable truths in these sketches, and these truths are not only of a moral nature, but we notice many physical facts mixed up in the stories.

It would be unfair to pass over the lyrics introduced, some of which are very pretty indeed. To us this is the best addition to fairy-story literature we have seen for some time.

Messrs. Hodder and Stoughton's Publications.

Second Notice.

(1) The Willoughby Captains. By Talbot Baines Reed.

Few men understand boy nature better than Mr. Reed.

The principal character of this charming school story is one who through his position as a scholar is made captain of his school, being no athlete of any kind.

This some of the boys so resent that they actually place another captain of their own choosing (one who captains the eleven and strokes the boat), as a sort of rival captain.

The former of these two captains is a thoroughly conscientious fellow, determined to do his duty at all costs. This he finds very hard to do, but in spite of all difficulties he does it, and brings the whole school, rival captain and all, to acknowledge his influence.

We have, of course, the couple of bad boys, of which one is worse than the other, and the deluded smaller boy who is drawn into their nets, and the mischievous lads who draw the line at what may be called vice; but though the characters are more or less familiar the incidents and the lines are new, and the volume will be devoured by schoolboys worthy of the name.

(2) The Boy without a Name. By W. M. Thayer.

This book is to our mind most unfortunately named—for the lad really has two names instead of none, viz., that which he received from his mother and that which he received from his adopted father.

We are told in a short preface that the story is true, and that the lad adopted from a Boston Home for Waifs really existed, and is now a useful minister in one of the American religious bodies.

The book is essentially American in thought, style and diction, and some of it may slightly jar on the English Churchman's feelings, but still we can understand it being of considerable use to many to encourage them in an uphill struggle.

(3) A Son of the Morning. By Sarah Doudney.

This volume does not treat of children but of young men and women with all their love affairs.

The hero of the book has been adopted by a wealthy pair, but on the death of the lady is separated from her husband.

The heroine is a charming young artist, who is engaged to a worthless fellow, whom she loves in that blind way that those with highly strung nerves are so apt to love. Her character is beautifully portrayed. Our not too young readers will find the volume well worth reading.

(4) Cost what it May. By Emma E. Hornibrooke.

This is a pretty story of Cavaliers and Roundheads, of whom we fancy the writer sympathises, perhaps the more with the latter than the former.

Of all the events that can happen in history out of which to make romance there can be nothing so fertile as civil war. Young men and women of different sides in the struggle are bound to come in contact with one another, and so we have it here.

Messrs. Blackie and Son's Publications.

Second Notice.

(1) The Seven Wise Scholars. By Ascott R. Hope, with Illustrations by Gordon Browne.

Every one knows how very much more difficult it is to write short stories than long ones, and yet how often we find our authors, as if ashamed of writing short stories, devising some clever scheme for linking a set of such together.

The device here is as follows: We are introduced to a pleasant old doctor who receives seven boys to educate; it is the first day of the term, and not having prepared their holiday task of Homer, they manage to put off the evil hour by beguiling the old doctor into hearing stories of their own composition, in which the possible is happily blended with the impossible.

The volume practically consists of these effusions, some of which are very funny, and rendered all the funnier by the clever pictures of Mr. Gordon Browne.

Considering that the stories must have taken several hours to relate, and that at their end the doctor very slyly leaves them in the schoolroom with orders to commit them to paper before they partake of dinner, we venture to fancy they must have been considerably famished before their tasks were over. We must of course accede this as a sort of literary license, much as we allow a letter of considerable length to be dashed off in a few seconds on the stage.

As the author puts into the mouth of the doctor an expression of the opinion that the story of number four is the best, we presume it is his favourite creation, and we think we are inclined to agree with him.

The volume will be found pleasant for reading aloud round the fireside, and the reading need not be put off till the little ones have gone to bed—though, we are bound to add, when speaking to the doctor, the young gentlemen in their own persons talk uncommonly 'tall.'

(2) By order of Queen Maude. By Louisa Crow.

This Queen Maude, who figures in the title page as the heroine of this little story, is not a Queen of royal descent, or of a people's choice, but only of a small party, who give her the name somewhat in scorn.

This young lady has been adopted by some good relation, but one day she decides that it is her duty to go home to her father's wifeless home and take care of him and her younger sisters and brothers. This she accordingly does, by no means however succeeding in disseminating happiness around as she had expected.

The most interesting personage portrayed is the second sister, who accomplishes a great deal more by the old-fashioned method of love than her elder sister by rigid discipline and modern methods, and this, we presume, is the moral of the story; though we can read pretty clearly between the lines, that the authoress is only too conscious how much harm people with the best of motives can do, though perhaps she would not go so far as to say, as some do, that all the harm in the world is done by good men and women.

(3) The Stories of Wasa and Menzikoff.

Though few young men and women go to Switzerland without having heard of William Tell, many have found themselves in the Tyrol and wondered who Hofer was whose statues and portraits are so prominent there.

The historical story books, which are now so common, ought to be doing something towards correcting this ignorance of other countries' deliverers and patriots.

We have here an account of Wasa, the deliverer of Sweden, of whom we all ought to know something, as well as of Menzikoff, the favourite of Czar Peter. These sketches our boy readers will find no less interesting than instructive.

(4) Dick o' the Fens. By Geo. Manville Fenn.

The hero of this charming story, with his boy friend Tom Tallington, are introduced to us just as the landowners and farmers have determined to drain the great fen in the east of Lincolnshire.

No improvement made by the hand of man has ever yet been unchallenged by men ignorant or selfish. In this case no doubt Mr. Fenn is well within the truth when he describes the opposition made to this great measure of reclaiming thousands of acres.

The opposition however takes a practical form in the shape of burning down homesteads, houghing horses and cattle, and even shooting at the engineer and the leading squire. The interest of the book, beyond the expeditions, enjoyed by the boys, for fishing, decoying, shooting, &c., lies in the suspicions which are attached to different people as to the outrages committed, even including Dick himself, who is the son of the squire.

We need scarcely add that the mystery is fully solved, and at last we find the lads returned to see fruitful fields where once was bog and water.

The character of the hero is a thoroughly healthy one, and no boy could read his history without being the better for it.

(5) Reign of Terror. By G. A. Henty.

The hero of this story is an English boy—was Mr. Henty afraid to make a French boy his hero?—who goes to France under very exceptional circumstances about two or three years before the guillotining of the king at the end of the last century.

In those years the boy inspires sufficient confidence in the breast of the nobleman in whose house he is, to be accepted as the guardian of his daughters should anything happen to him and the marquese.

Though he cannot rescue the marquis and his wife, after they have been imprisoned by the Commune, he succeeds in the most marvellous way in saving first the eldest daughter and later on the younger ones.

Mr. Henty acknowledges a slight anachronism in the preface, but it would have been a pity to omit so striking a picture as he has given of one of the worst phases of the cruelty of the times.

The lesson of those awful times is one perhaps more necessary to be learnt by rulers than boys, but after all boys soon become men, and who knows but that some who read this story may not by and bye profit by its lessons, and by the exercise of sharp though necessary discipline, save an infinity of suffering.

(6) Sturdy and Strong. By G. A. Henty.

This is a story of two English lads. One of them, reduced to straits through no fault of his own, becomes acquainted with a poor waif, whom he teaches to be honest and industrious. For a time they have a hard time of it, but an accidental circumstance makes him a friend, who assists him and his friend with work. They are industrious and careful, and another accidental circumstance, of a more serious nature, intensifies his benefactor's kindness.

Mr. Henty evidently wishes his boy readers to realise that in the climb up the hill of success most men have some so called accidents which they may use as tufts of grass with which to help them up, and that many, who complain of their luck have only themselves to blame for not profiting by the chances they have really had, because they lack the industry and high principle to use them aright.

(7) The Princess and the Goblin; and

(8) The Princess and Curdie. By George Macdonald, LL.D.

These two wonderful fairy tales in the child-loving doctor's best style, are really only one story. We have Curdie, a little younger, in the former, and the goblins have mostly if not quite disappeared in the latter. To quote from the last page of the earlier narrative 'most of them (the goblins) soon left that part of the country, and most of those who remained grew milder in character, and indeed became very much like the Scotch Brownies. Their skulls became softer as well as their hearts, and their feet grew harder, and by degrees they became friendly with the inhabitants of the mountain and even with the miners.'

It would be cruel to say anything of the strange story, but young readers must learn to see all the good lessons the great doctor would teach them.

In the second story, we may state, there is a certain amount of physical geography most charmingly taught.

We trust all the children who receive the Princess and Curdie, who is a dear good lad, the son of a miner, may have an opportunity given them of reading the Princess and the Goblin first, as the perusal of the former will considerably intensify the interest of the latter.

(9) The Rover's Secret. By Harry Collingwood.

This is a sea story such as few can write better than Mr. Collingwood. The hero of the story is introduced to us as a child, living alone with his father and servants, the former of whom acts very strangely towards his lady, there being some mystery, which is eventually solved, about the boy's mother.

He goes to school, but we hear nothing of his school life, except that he stays at school continuously, not even returning to his father in the vacations.

He then joins the Royal Navy as a midshipman, the time of the story being the end of the last century.

From this point we have a series of stirring events, which we need not refer to, in which the boy plays his part more or less actively, until we leave him a post captain, to which rank he had been, according to some, 'indecently hurried,' but which, in the eyes of his admiral he had 'faithfully earned.'

(10) Margery Merton's Girlhood. By Alice Corkran.

This authoress has for once left her usual fields of fairyland, and given her young readers a story of a very natural little mortal. She is again assisted by Mr. Gordon Browne, but he is not as happy in pictures of real men, women and children as of goblins and fairies, nor has he in one instance taken the trouble to master the text sufficiently to see exactly the picture intended by the authoress. We do not wish to be hypercritical, but we cannot help thinking that illustrations to books of this kind had far better be left out altogether, than to exhibit any inconsistencies, however slight.

An old lady living in Paris has a small child of her dead niece thrust on her hands. She has long theorised on the way to bring up children, and her neighbours, now that she is personally responsible, are very anxious to see how her code will answer; we need scarcely add it fails in every particular, in all contests the child coming off victorious.

An artist, a widower, who is attracted to the child, and very fond of the old lady, bluntly tells the latter the reason of her failure is that she has never been a mother, and suggests that the widow of a friend of his, who has also lost her children, should be engaged to educate the child.

The way in which this childless mother and motherless child mutually comfort and support one another is most touchingly and artistically portrayed.

After the death of the old aunt the child studies painting as a future profession, and the principal interest of this part of the work lies in a great art contest in which readers will find themselves intensely interested.

(11) Sir Walter's Ward. By William Everard.

This is a tale of the Crusades, when Frederick was allowed to be crowned, or rather to crown himself, King of Jerusalem on the condition that the Temple of Solomon, as the great mosque was called, was allowed to remain in the hands of the Mahometans.

The Sir Walter whose name appears on the title-page is none other than the minstrel Sir Walter von der Vogelweide, one at least of whose extant hymns is given in the book. The ward is the son of a knight who was slain in a crusade, whom his mother has brought up very quietly in a smaller castle, leaving the knight's principal castle to his uncle to take care of during the boy's minority.

They find out that this uncle is plotting against the life of the young man, and this is what leads the minstrel to take him off to the crusade.

The efforts of the wicked uncle and his unscrupulous seneschal, who by the way was an expelled monk, to obtain the boy's life, are the most interesting parts of the volume, the historical portions not being so well done. The book, however, is on the whole very interesting, and would be, in spite of what we have said above, an acceptable prize to any boy fond of history.

(12) A Pair of Clogs. By Amy Watton.

We almost think this little sketch of 100 pages is the prettiest story we have seen this Christmas.

Through the cruel action of gypsies the clogs get separated for seven long years, but indirectly by means of the same gipsies are united again.

There are two other shorter stories by the same author in the same volume, entitled 'The Truslow Ghost,' and 'After All,' both of which are well worth reading.

(13) The Squire's Grandson. By J. M. Callwell.

We have here an exceedingly pretty account of how a little fellow goes on his own responsibility to his grandfather to heal a rupture of many years' standing between his father and the old gentleman.

The author has forgotten that children travel half-price, and that therefore he was not penniless or nearly so, when he arrived at his grandfather's, having had sufficient given him for a whole ticket; but this is a matter of very small moment. The little fellow is intensely lovable, and our interest in him is very real.

The next six volumes are very small ones, only containing 128 pages each, but are attractive in appearance.

(14) A Boy Musician; or, the Young Days of Mozart.

With a wonderful boy amongst us cramming one of our largest halls to hear him perform, it was a happy thought to tell children in this pretty way of the wonderful boy musician of the last century.

It is impossible almost to hear or think of Josef Hoffman without at the same time thinking of Mozart, they seem to have so much in common. We have all the well-known anecdotes here, which children will like to read.

(15) The Cruise of the Petrel. By F. M. Holmes.

If this little volume does nothing else, it certainly shows the enormous blessing of the training ships now used as refuges for the waifs and strays of our great cities.

This poor little half-starved lad becomes a most useful member of the Merchant Service, and ought to be the means of increasing the subscriptions from the young towards these useful charities.

There is a second story in the same cover called 'A Miser's Million.'

(16) The Wise Princess and other Stories. By M. Harriet M. Capes.

These are short stories, suitable for reading aloud to young children, of which the first is a fairy tale, pure and simple, and the second a very funny and, to our mind, somewhat silly account of a princess becoming enamoured of a star, for whose sake she disobeys her father in the matter of marriage, and dies in one of his dungeons. The remaining stories are of a more commonplace description.

(17) Hatto's Tower and other Stories. By Mary C. Rowsell.

Supposing there is a grain of truth in this old tradition of the Rhine, for mother church's sake it might be as well perhaps to forget it as soon as possible.

The authoress, however, does not think so, and we must add she has done her work well.

Messrs. Cassell & Co.'s Publications.

We have received from these enterprising publishers a parcel of volumes considerably varied in their nature. We cannot head this notice with the term 'Prize Books,' for though some of them are admirably suited for that purpose, we could not recommend the presentation of the last as a prize to any boy (much less girl), even though nearly of man's estate.

(1) Bo-Peep. A Treasury for the Little Ones.

This is a delightful book for children, in which the pictures are really well drawn, and a help to the little ones in their efforts to read the easy letterpress for themselves.

We cannot help noticing some bold outlines for children to copy on their slates, which are above the average of such drawings.

The paper and the printing, which are of considerable consequence in such books, when intended for children so young, is wonderfully good and clear.

(2) Little Folks.

Though this is the year's volume of a monthly magazine, it seems as if it must be a reprint of the several numbers, as there is nothing to show where the different numbers begin and end, and the paging is continuous.

This volume is intended for older children than the former one, and contains two or three long stories which are completed.

We were much struck with a series of papers entitled 'On Sunday Afternoons,' by the Rev. Frederick Langbridge, in which the religious teaching, interwoven as it is with stories, is healthy and valuable.

The pictures are an important factor of the volume, and fully up to Messrs. Cassell's high standard.

We should like to notice some of the stories, but our space prevents us. We can only say that there are bound up together a great many stories, in fact, in all, as much reading as could be got in separate volumes for some five or six times the money.

(3) Ships, Sailors, and the Sea. By R. J. Cornewall-Jones.

This is not a story book in the ordinary sense of the word, but a series of chapters giving information on the subjects.

This work is divided into thirty-four chapters, on such subjects as—Different kinds of vessels; Lighthouses; Flags; Lord Nelson, the battle of the Nile; Crossing the line; the weather; the life boat; and going to sea.

The illustrations are of real value and help in the understanding of the text.

The information, especially that contained in the last chapter, would be invaluable to those interested in lads, and getting them out into the world; at the same time, we are sure boys with any taste for the sea will enjoy this volume of facts interspersed with histories of real personages, as much as the fictions on the same subject, in which lads in a short time often pass through the possible experience of a dozen such in double the time.

(4) The World's Workers. Mrs. Somerville and Mary Carpenter. By Phyllis Browne.

This is a happily conceived series of volumes, most liberally and usefully carried out.

The young ladies of Girton and Newnham must not think that because their mothers and grandmothers were not allowed to sit for places in the learned triposses, that they therefore had no mental strength.

We should very much doubt if any young alumna of Oxford or Cambridge ever exhibited more mathematical power than the former of these two ladies; and there is a lesson she can teach them, which all of them, more or less, want to learn viz., that, however much a lady's head may be in the stars her feet must be very firmly planted on the earth, with its home duties and responsibilities.

The sketch of Mary Carpenter tells us of how much one wanting to be useful can do if she will only look out for opportunities, and the study of her life cannot but be of immense use to any young woman with a realisation of the reality of life and its possibilities.

(5) The Prose Works of Longfellow.

This is a volume of the well known Red Library issued from time to time by this firm. It contains Outre Mer, Hyperion, and Kavanagh.

In Outre Mer, our young readers may like to know, we have the poet's impressions of France, Spain, and Italy, interspersed with other papers, as old English Prose Romances, and the Martyrdom of the Baptism of Fire. The student will find the paper called Ancient Spanish Ballads exceedingly entertaining.

Hyperion and Kavanagh are, we may mention, stories. The print of this volume is necessarily small, owing to the amount of matter contained in its 390 pages, but beautifully clear, which clearness is considerably enhanced by the goodness of the paper. It is not our rule to quote the price of volumes we review, but we can assure our readers that this is a wonderful book for the price in every way.

(6) Dead Man's Rock. A Romance. By Q.

This is the volume we referred to in our opening sentence as to this parcel of books as being utterly unsuitable for children, or even boys and girls.

The story is one of horrors from beginning to end, and without careful calculation we could scarcely tell how many murders are recounted within its pages.

At the same time, that it possesses a weird fascination we are bound to acknowledge, and the descriptions of scenes and events are most vivid.

The work is divided into two parts, the former of which is called 'The Quest of the Great Ruby,' and the second 'The finding of the Great Ruby.' We all remember Wilkie Collins' clever story of the Moonstone, but this story is on different lines altogether; at the same time we are sometimes reminded of Rider Haggard's method of dealing with mysteries.

We see the book has already reached its fifth thousand, and we shall be very much astonished if it does not ere long multiply that circulation tenfold at least.

Unfinished Worlds—a Study in Astronomy.

By S. H. Parkes, F.R.A.S., F.L.S. London: Hodder and Stoughton.

This is a very readable book, affording a capital insight into the latest development of astronomical research and theory. It is written forcibly and clearly, and the author is to be congratulated on the masterly manner in which within the compass of comparatively speaking a few pages he has given a really comprehensive view of the marvellous discoveries effected by modern science in this particular direction. Starting with the assertion that change, ceaseless change, is one of the most evident conditions of material creations, whether organic or inorganic, the truth of this dictum is gradually unfolded and shown to apply not only to our own solar system but also to the most distant star groups and scattered nebulæ which the telescope and spectroscope have revealed. The results of the enormous progress which has been made of late years in mechanical arts and sciences are perhaps in no respects more striking and manifest than in the improvements effected in astronomical instruments. Absolute mechanical perfection is of course only an ideal, but so nearly has modern instrumental precision approached this ideal in beauty of design and accuracy of manufacture that at present it is difficult to see how any further progress is possible. Equipped with instruments of this reliable character, and with the spectroscope and photographic camera to lend their aid to the telescope, modern astronomers have pierced space and gazed into stellar depths unfathomed by their predecessors. They have detected forms and peculiarities undreamt of by previous investigators in those 'strange weird-looking things, shining dimly through the depths of space, called nebulæ,' and in the case of the other heavenly bodies have had revealed to them changes and appearances of an equally marvellous and unexpected character. What these appearances and revelations have been, and what theories and speculations have been framed upon them, are well described in Mr. Parkes' interesting pages, and we can consequently well recommend their perusal to all who are interested in astronomical matters.

The book is singularly free from technical terminology, a fact which is an additional recommendation to the general reader, and the plates too are excellent in their way. We are sorry we have in any way to qualify our praise in respect to these latter, but we must confess that in our opinion they would gain materially as elucidators of the text if a little less prominence had been given to the name of the process employed in their production, and a little more to the designations of the stellar appearances they are supposed to depict. In the particular copy of the work now in our hands Plate X appears at page 128, and is evidently misplaced—probably by an accidental oversight on the part of the binder. It should be relegated to page 227 of the Appendix, where an interesting account is given of Dr. Dallinger's careful and laborious researches into the effects of progressive and long sustained increments of temperature on the life-history of certain monads.

Owing to pressure on our space, several reviews are unavoidably held over.

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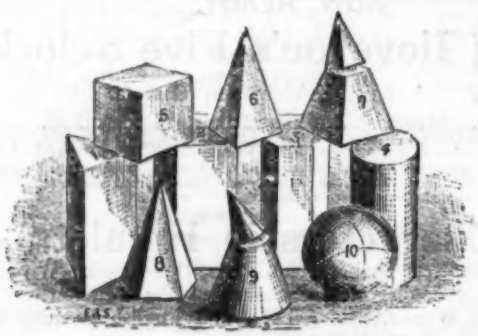

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